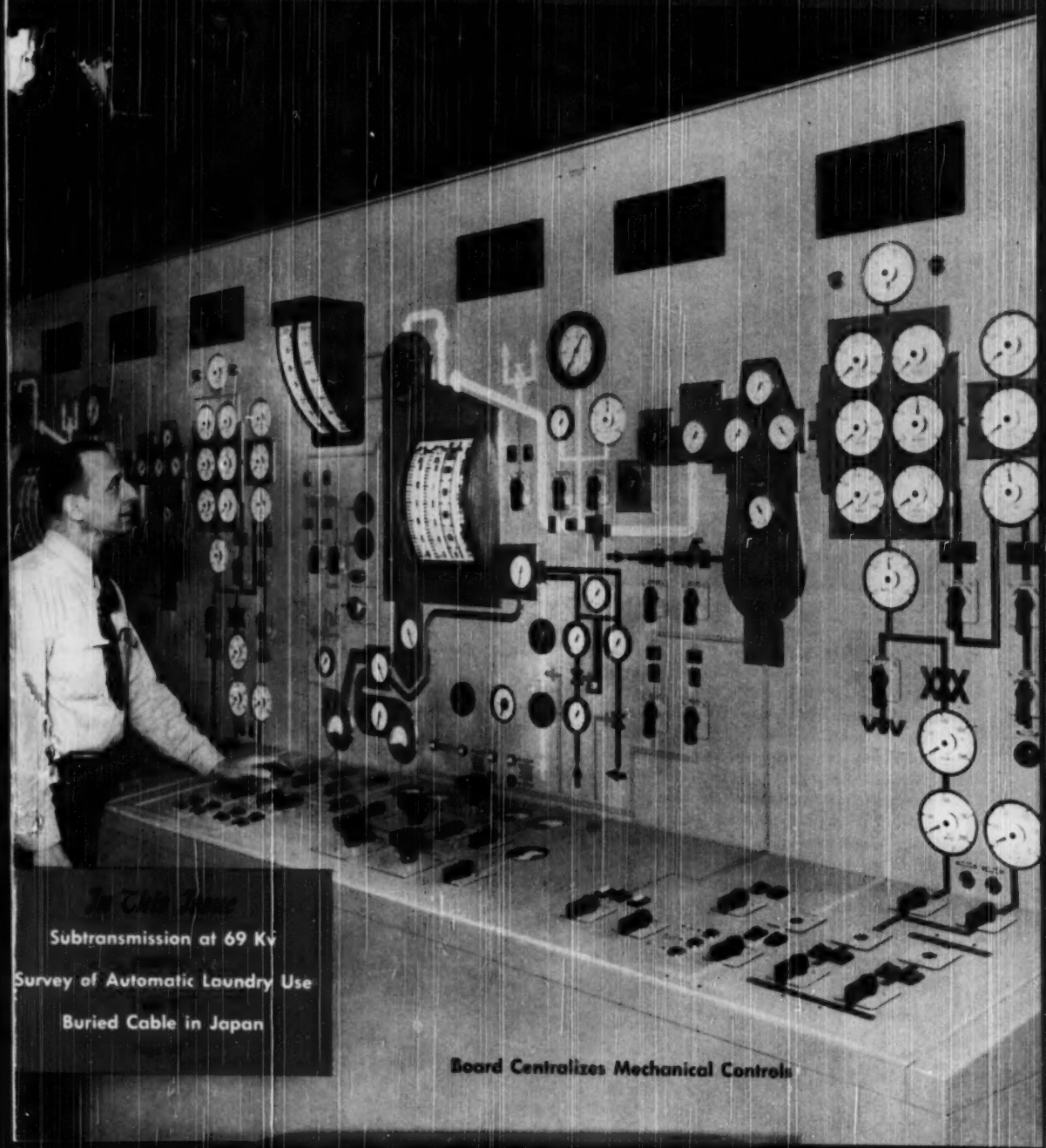
ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION



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Subtransmission at 69 Kv

Survey of Automatic Laundry Use

Buried Cable in Japan

Board Centralizes Mechanical Controls

Additives alone won't make a good turbine oil. But *Texaco Regal Oils (R & O)* combine a base stock (Texaco Regal Oil), that is a world-famous turbine oil in its own right, with effective additives that enhance its natural resistance to rust and oxidation. Then special processing makes it anti-foaming.

Result: *double* assurance of *extra* protection for your turbines. This has been proved by the continuous records that are kept of every Texaco lubricated turbine. *Texaco Regal Oils (R & O)* have remarkable records for long service life, absence of sludge formations, protection against rust and foam.

Texaco Regal Oils (R & O) keep turbine lubricating systems clean, bearings constantly protected, governor action sensitive and alert. They meet the stringent requirements of all leading turbine builders . . . and there is a complete line to assure effective lubrication under all operating conditions.

Let a Texaco Lubrication Engineer help you get more efficient performance . . . at lower cost . . . from all your power plant machinery. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

OF PERSONAL INTEREST

Nobody likes mistakes. Making one in the utility business can stand out like a sore thumb because it may bring discomfort or at least inconvenience to a good many customers.

Sometimes people do pull the wrong switches, give improper instructions, place ground wires incorrectly, etc. They call these operating mistakes.

Pennsylvania Power & Light made so many of them in 1948 that the company became concerned at a "downward trend in operating efficiency."

Something had to be done, that was clear. First step was to get detailed knowledge of past mistakes, then maybe future ones could be reduced.

Operating history for 25 years was studied minutely to try to find:

1. Major factors responsible for frequency of mistakes.
2. Personal factors responsible.
3. Occupational conditions responsible.

Some surprising facts came to light. For example: operating mistakes follow business cycles. Employees make far more mistakes during periods of prosperity than they do in times of depression.

The findings (which may help **you** avoid some mistakes) are documented and charted by V. O. Boland, Supervisor of Operating Instructions, Pennsylvania Power & Light Co, in **Electrical World** for Aug. 14. **Electrical World** constantly changes to fit the desires and needs of its readers. Our newest change is a small one—the "Letters to the Editor" page is now the last page in the magazine (next to the "third cover.") It's a more convenient place because "Letters to the Editor" is growing in popularity.

THE EDITORS.

ELECTRICAL WORLD

Published for 76 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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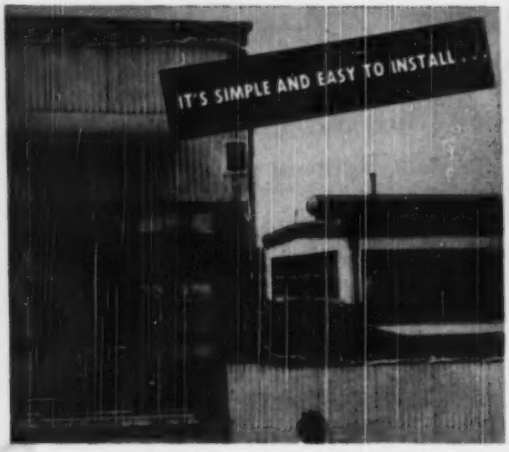
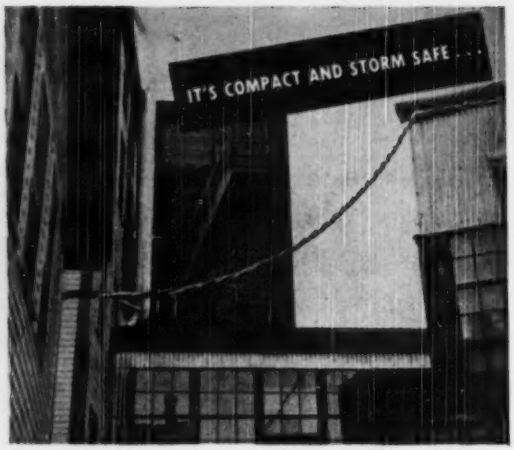


Pre-assembled cable, messenger and binder construction goes up fast and easy — all in one operation. No special equipment or technique is required. Important time and installation costs are saved.



Full support between points of suspension is provided by a Copperweld messenger, bound to the cable by a spirally wound metallic tape. This simple *all-in-one construction* (cable, messenger, binder) results in a compact cable design that requires little space, makes a neat appearing installation.

Installation economies provided by Hazard Self-Supporting Cable design reduce your first costs. And once up, little or no maintenance is required. Lasting protection against the roughest weather, tree branches, sun, oil, moisture, etc., is provided by the exceptional mechanical strength of the cable design, the well known, tough characteristics of a Hazaprene (neoprene compound developed by Hazard) Sheath, and the long-aging, moisture resistant qualities of Hazard Watertite insulation.

Typical of the benefits and advantages gained through the use of Hazard Self-Supporting Aerial Cable is this neat appearing installation at The L. S. Starrett Company, Athol, Mass. More and more industrial plants, as well as utilities are turning to self-supporting cable in answer to today's needs for circuit expansion and modernization. A wide variety of cable designs meets all types of service requirements.

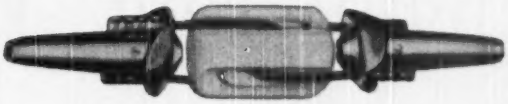
It will pay you to write for full information about the advantages of Hazard Self-Supporting Aerial Cable or ask your Hazard representative. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

HAZARD insulated wire and cable for every electrical use

8375

Electroline Automatic Insulating Line Splice SECTIONALIZERS

2200 AND
2300 SERIES



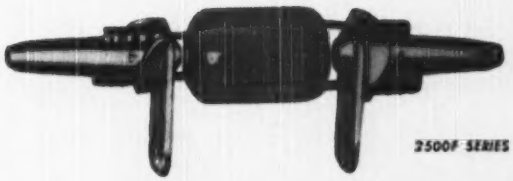
2500 SERIES

These Automatic Insulating Line Splice Sectionalizers offer a large number of line applications —at the lowest possible cost. You'll find these Electroline Sectionalizers ideal for

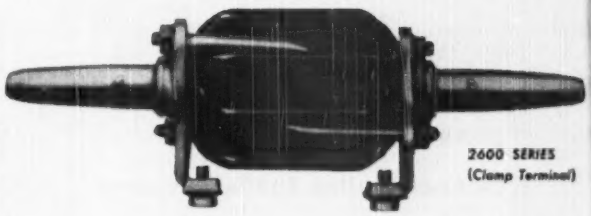
- **REGULATING SECONDARY VOLTAGES**
  Facilitates secondary voltage regulation when used to bank transformer secondaries.
- **FUSING TRANSFORMERS**
  Gives transformers real protection when used to fuse transformer leads.
- **SECTIONALIZING NETWORKS**
  Suitable for sectionalizing networks to isolate the area in trouble.
- **SERIES STREET LIGHTING**
  Simplifies cutting-in series street lamps—merely cut the line and insert conductor ends into sectionalizer.

The mechanical strength of these assemblies exceeds in all cases the rated breaking strength of the conductor size for which they are adapted.

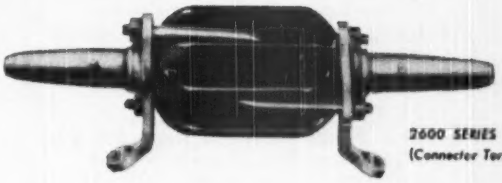
The wet process porcelain insulators used in the 2500 and 2600 series sectionalizers can, if desired, be furnished with a white glaze to reflect the beam of the lineman's searchlight when locating trouble at night.



2500F SERIES



2600 SERIES
(Clamp Terminal)



2600 SERIES
(Connector Terminal)

Send for New Bulletin

Electroline Company

4121 South La Salle Street • Chicago 9, Illinois • IN CANADA—POWERLITE DEVICES, LTD., TORONTO

2,000,000 KVA CAPACITY... WITH

a fuse engineering "FIRST"

Six 115,000-volt SMD-2 Power Fuses, connected two-in-series on each phase, provide 2,000,000 kva three phase symmetrical interrupting capacity at this recently built substation in New York State. This is the first application of fuses for system short circuit protection on such high concentration of power.

The six fuses, costing $3510.00, demonstrate the possible savings over breakers when the latter are not essential to satisfy switching and relaying requirements.

The SMD-2 Fuses pictured here are applied in the primary of a 7500-kva station service transformer directly connected to the 110,000-volt main bus where the available short circuit kva is 1,600,000, symmetrical.

SMD-2 Power Fuses, proved for FULL COVERAGE* protection by several years' service in ratings up to 138,000 volts, are now available down to 34,500 volts.

Your inquiries on similar high interrupting capacity or other possible applications of SMD-2 Power Fuses are invited. New descriptive information is just off the press. Ask for Catalog Section 262.

S&C ELECTRIC COMPANY

Formerly SCHWEITZER & CONRAD, INC.

INTERRUPTING 115,000 VOLT FUSES

✻ **FULL COVERAGE PROTECTION IS:** the new concept of transformer fusing in which:

A primary fuse is applied for both primary short circuit and secondary back-up short circuit protection. A fuse is expected to perform dependably regardless of type of system; type of fault current; type of application; or system and atmospheric conditions.

✻ **FULL COVERAGE PROTECTION PROVIDES**— along with the above protection—savings in operating expense by:

Eliminating the need for replacement of "suspect" fuses on other phases when one fuse blows.
Eliminating the need for periodic replacement of fuses to prevent "sneak-outs" caused by vibration- or age-weakened fusible elements.

✻ **FULL COVERAGE PROTECTION REQUIRES:**

dependable high and low fault-current interrupting ability;
protection against dielectric breakdown or external flashover from severe recovery voltage;
a fine degree of accuracy in time-current characteristics;
a "non-damageable" fusible element which cannot be injured by surge currents, vibration, or aging;
a choice of time-current characteristics to provide flexibility in coordinating with other primary, and with the secondary, protective devices.

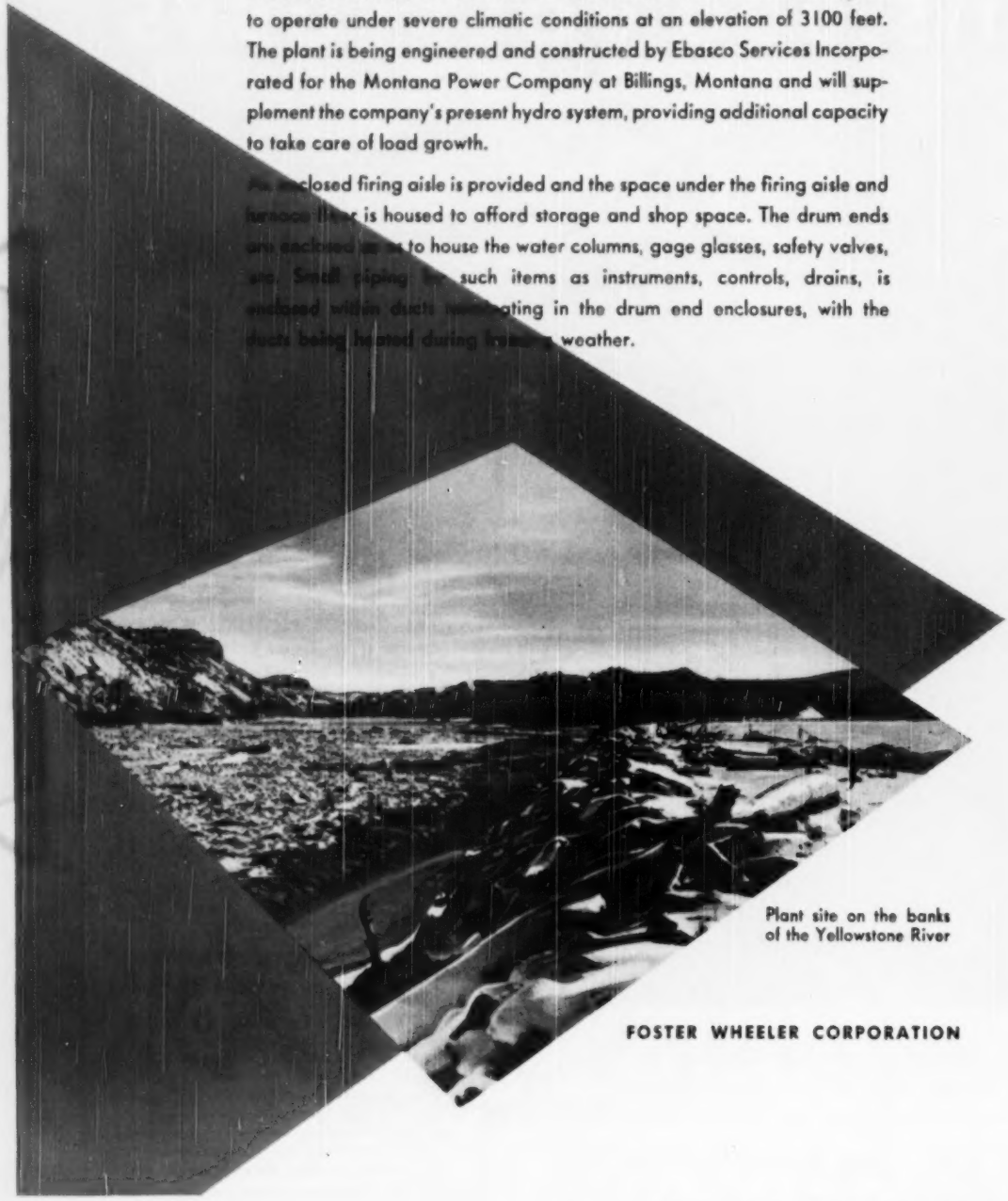
4421 Ravenswood Avenue
Chicago 40, Illinois, U. S. A.

In Canada, Powerlite Devices, Limited, Toronto

"operation" SUB-ZERO

The Foster Wheeler Outdoor Steam Generator illustrated here is designed to operate under severe climatic conditions at an elevation of 3100 feet. The plant is being engineered and constructed by Ebasco Services Incorporated for the Montana Power Company at Billings, Montana and will supplement the company's present hydro system, providing additional capacity to take care of load growth.

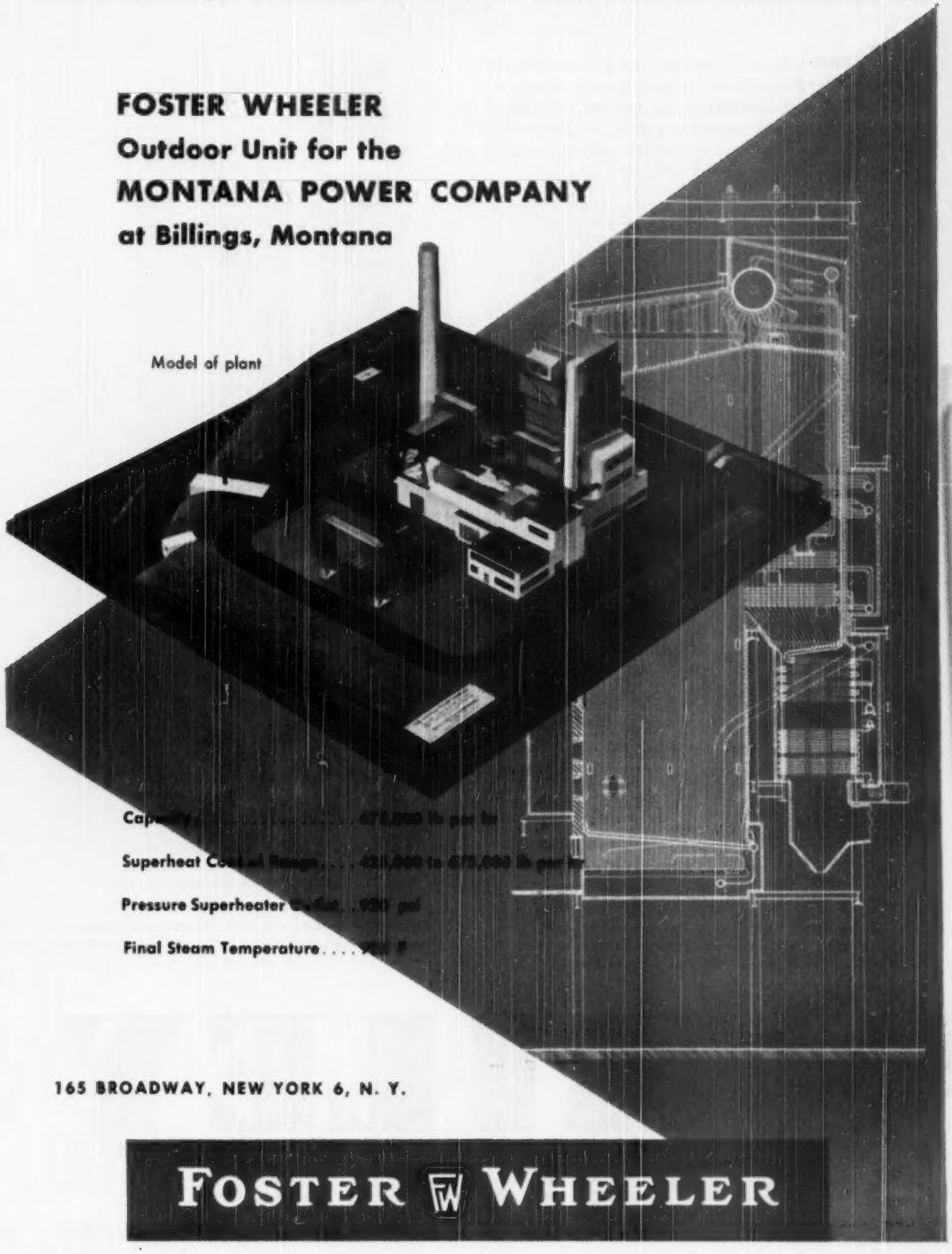
An enclosed firing aisle is provided and the space under the firing aisle and furnace floor is housed to afford storage and shop space. The drum ends are enclosed as to house the water columns, gage glasses, safety valves, etc. Small piping for such items as instruments, controls, drains, is enclosed within ducts terminating in the drum end enclosures, with the ducts being heated during [illegible] weather.



Plant site on the banks of the Yellowstone River

FOSTER WHEELER CORPORATION

FOSTER WHEELER
Outdoor Unit for the
MONTANA POWER COMPANY
at Billings, Montana



Model of plant

Cap[illegible] . . . . . 675,000 lb per hr

Superheat Control Range . . . 420,000 to 675,000 lb per hr

Pressure Superheater Outlet . . 925 psi

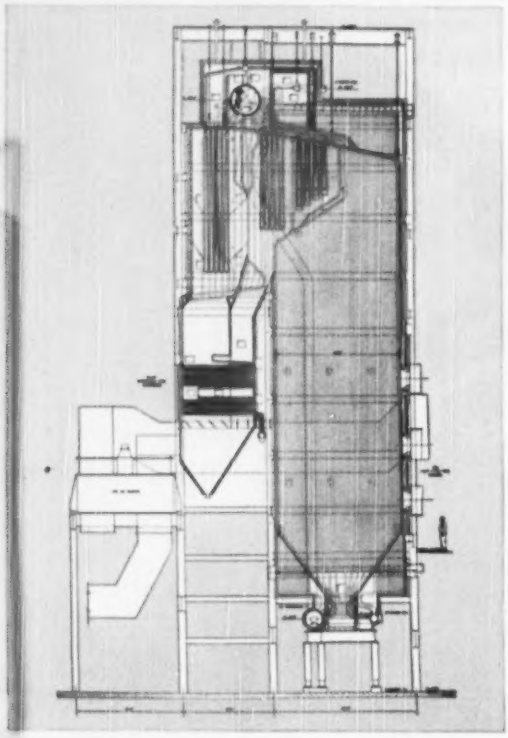
Final Steam Temperature . . . 900° F

165 BROADWAY, NEW YORK 6, N. Y.

FOSTER FW WHEELER

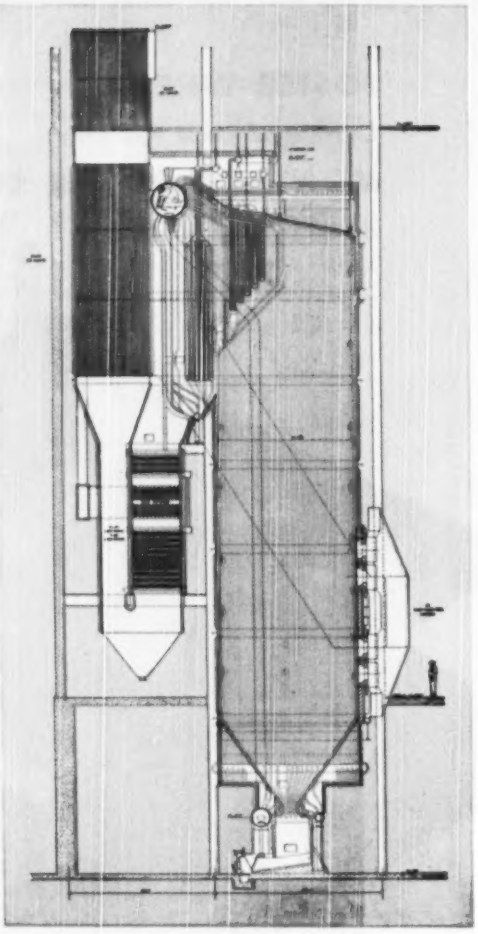
all across the country, Public

THERE is a very noticeable swing among Public Utilities to Riley Steam Generating Equipment. More and more Public Utility Companies are making their initial installation of Riley equipment and those companies who have tried Riley equipment are, almost invariably, coming back for more Riley units when expanding capacity.



JORDAN STATION, Utah Power & Light Co.
620,000 lbs./hr. 1500 lbs. 955°F. Riley Unit
Bechtel Corporation, Consulting Engineers

Utah Power & Light Co. has also installed a 400,000 lbs./hr. Riley unit at their Orem Station and are intalling a 60,000 lbs./hr. unit at Western Colorado Power Co.



R. S. WALLACE STATION, Central Illinois Light Co.
600,000 lbs./hr. 950 lbs. 910°F. Riley Unit

This is the fifth Riley unit to be installed at this station. Four 300,000 lbs./hr. Riley units have been previously installed.

TRADE MARK Rx REGISTERED

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STOKER CORPORATION, WORCESTER, MASS.

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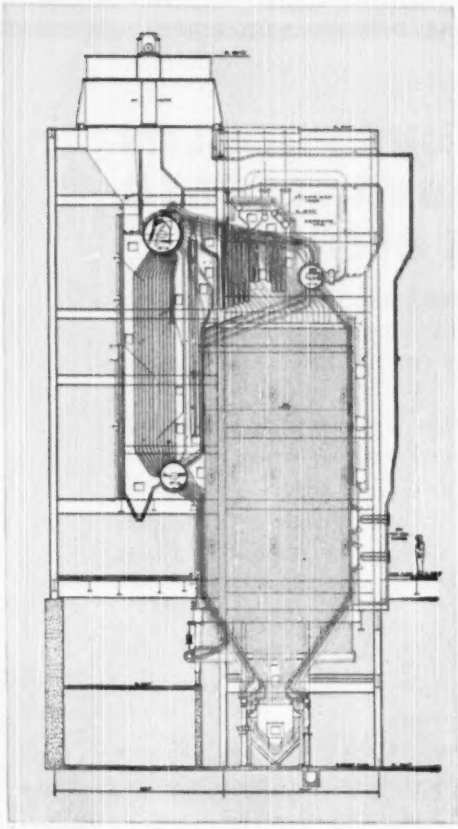
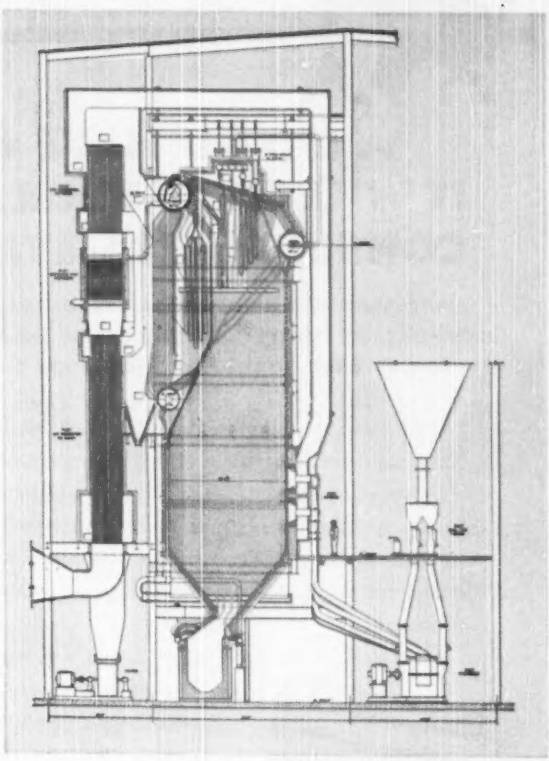
Utilities are SWINGING to Riley Units



EDWARDSPORT STATION, Public Service Co. of Ind.
400,000 lbs./hr. 1000 lbs. 910°F. Riley Unit
Sargent & Lundy, Consulting Engineers

Public Service Co. of Indiana has installed Riley units at Dresser and Noblesville stations also—six Riley units, total capacity 2,000,000 lbs. of steam per hour. An additional unit is on order for the Edwardsport station.



RIVERTON STATION, Northern Virginia Power Co.
350,000 lbs./hr. 1100 lbs. 900°F. Riley Unit
Sanderson and Porter, Consulting Engineers

You Can Rely on Riley

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly l... ... costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment.

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD ...ULATED SETTINGS • AIR HEATERS

Metal-enclosed buses

. . IF YOU HAVE A BUS PROBLEM IT WILL BE TO YOUR ADVANTAGE TO CONSULT DELTA-STAR BECAUSE—

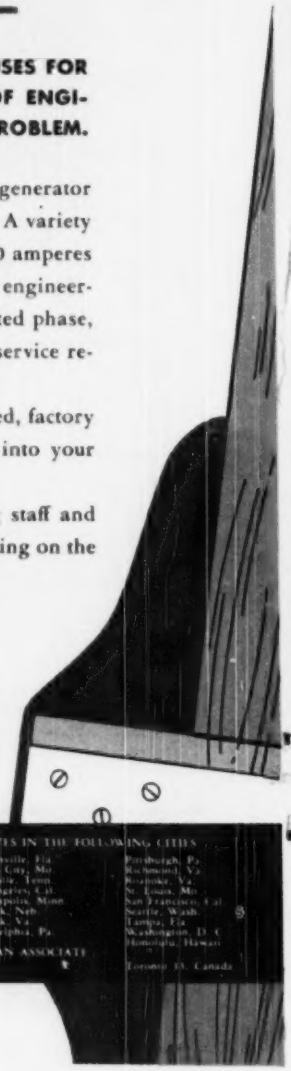
DELTA-STAR HAS DESIGNED AND MANUFACTURED MANY TYPES OF BUSES FOR IMPORTANT UTILITY AND INDUSTRIAL INSTALLATIONS. ITS STAFF OF ENGINEERS IS WELL QUALIFIED TO HELP YOU SOLVE YOUR PARTICULAR PROBLEM.

The largest application of metal-enclosed bus is in the protection of large generator leads, but there are other bus installations where it can be used to advantage. A variety of designs in voltage ratings up to 23-kv and current ratings as high as 6000 amperes are available to choose from. Since each type offers particular advantages, an engineering analysis is made of each proposed installation to determine whether isolated phase, segregated phase or non-segregated phase will be most economical for the service requirements.

Regardless of the type selected, you are assured of a factory engineered, factory assembled and factory tested bus, designed to fit into your installation at low erection cost.

Discuss your bus problem with our engineering staff and investigate our manufacturing facilities before deciding on the best type of construction for your particular needs.

Call or write the factory or nearest representative and ask for Publication 5006 describing the safety and other advantages of Delta-Star factory built metal-enclosed buses.



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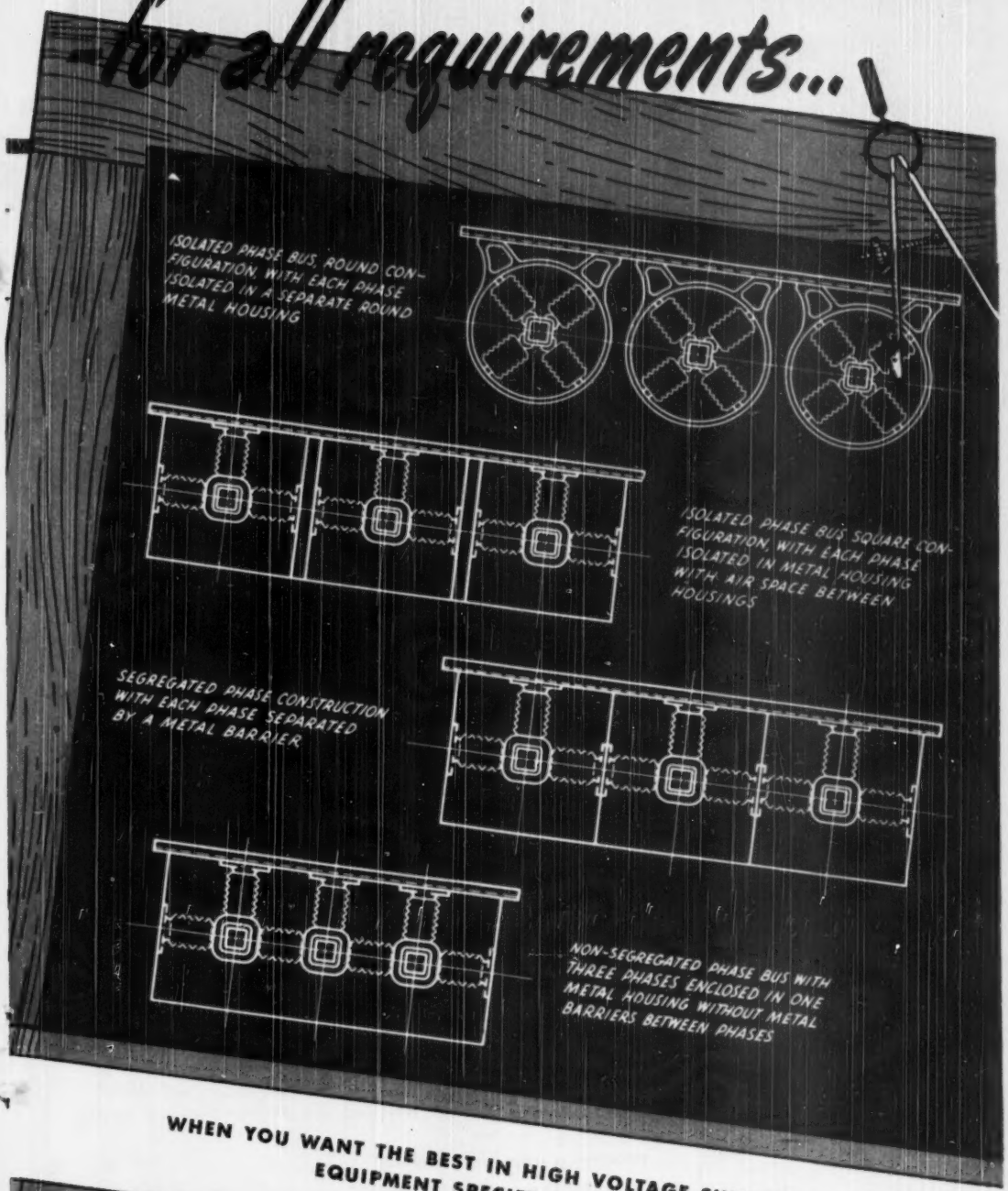

ISOLATED PHASE BUS, ROUND CONFIGURATION, WITH EACH PHASE ISOLATED IN A SEPARATE ROUND METAL HOUSING
ISOLATED PHASE BUS SQUARE CONFIGURATION, WITH EACH PHASE ISOLATED IN METAL HOUSING WITH AIR SPACE BETWEEN HOUSINGS
SEGREGATED PHASE CONSTRUCTION WITH EACH PHASE SEPARATED BY A METAL BARRIER
NON-SEGREGATED PHASE BUS WITH THREE PHASES ENCLOSED IN ONE METAL HOUSING WITHOUT METAL BARRIERS BETWEEN PHASES

WHEN YOU WANT THE BEST IN HIGH VOLTAGE SWITCHING EQUIPMENT SPECIFY DELTA-STAR

ABRIDGED SPECIFICATIONS

SOUND-LEVEL RANGE: +24 db to +140 db

MICROPHONE: Mounts on bracket to fold into case; crystal diaphragm type essentially non-directional and unaffected by ordinary temperature and humidity changes; extension cord and tripod available as accessories.

CALIBRATION: sensitivity of electrical system can be calibrated any time by built-in calibration circuit.

SLOW-FAST METER: switch selects either slow or fast meter damping.

REQUIRES NO BATTERY ADJUSTMENTS: uses single block battery.

A SIMPLE INSTRUMENT FOR NOISE MEASUREMENTS

THE General Radio Type 759-B Sound-Level Meter offers the simplest, most convenient and most direct instrument for determining accurately the exact amount of noise made by any moving machinery.

Battery-operated, portable and completely self-contained this meter can be operated by anyone with a few minutes study of the instructions mounted in the cover of its carrying case.

Its range of +24 db to +140 db covers everything from the quietest of acoustically-treated sound rooms to the blast of a locomotive whistle. Its accuracy is more than is required for practically all sound-level measurements in industry.

Associated equipment includes a Sound Analyzer by means of which the actual amplitude of the component frequencies of any sound may be measured. Similar equipment for the accurate measurement and analysis of vibration is available.

If you have any problem involving the measurement and analysis of either sound or vibration, very likely this equipment can be of great help to you.

TYPE 759-B SOUND-LEVEL METER $320.00

Write for "THE NOISE PRIMER" for Complete Information

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 · 920 S. Michigan Ave., Chicago 5 · 1000 N. Seward St., Los Angeles 38

METAL ENCLOSED ISOLATED PHASE BUS STRUCTURES by R&IE

now up to 69 kv.

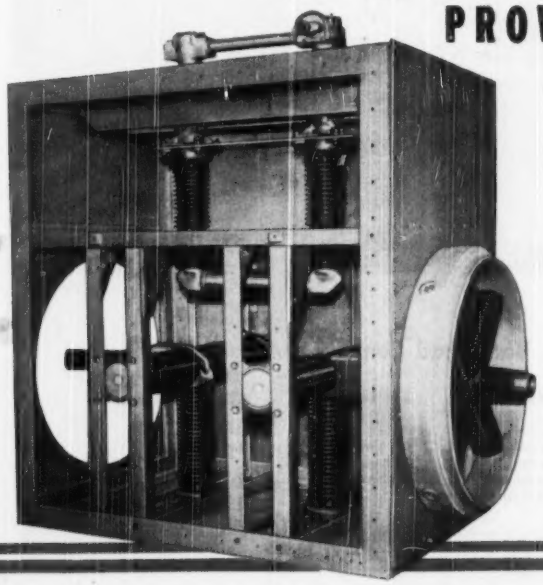
Because it's a PROVEN DESIGN..

backed by

THIRTEEN YEARS

of

PREVIOUS FAVORABLE OPERATING EXPERIENCE



At left is shown a typical assembly of a 69 Kv. metal enclosed, double break, disconnect switch now being made at R&IE. Three pole switches are operated with bevel-geared interconnecting shafts, interlocked with associated switchgear with Kirk Key Interlocks.

RAILWAY and INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO

The Check List

- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- CONDUCTOR SUPPORTS CLAMPS AND FITTINGS
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- DISTRIBUTION EQUIPMENT
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SWITCHING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

"Just when do I use

It isn't easy to decide what type of insulation to specify for electrical wire and cable. But the job will be a lot easier if you use the experimental and practical knowledge of American Steel & Wire Company engineers. These engineers know that varnished cambric insulation has a combination of properties that are unmatched by any other one insulation.

To start with, varnished cambric is superior to rubber when it comes to heat resistance and load capacity—it can be used at operating temperatures up to 85°C. And, because of its higher dielectric strength, varnished cambric insulation walls can be thinner than rubber. But unlike rubber, varnished cambric requires a waterproof covering if it is to be continuously exposed to moisture.

Paper insulation is more susceptible to ordinary moisture than varnished cambric. And, although varnished cambric is not as flexible as rubber, it is much easier to handle and simpler to install than paper insulated cables.

Varnished cambric has one big advantage over both natural rubber and paper: It is not affected by oil and grease.

Available Types of American Varnished Cambric Cables

CONDUCTORS:	OUTER COVERINGS:	FINISHES:	ARMOR FINISHES:	LEAD SHEATHINGS:	RUBBER SHEATHINGS:
solid	cotton braids	black wax	flat steel tape	plain	where lead
stranded	asbestos braids	firefite	interlocking metal tape	jute served	cannot be used
extra-flexible	tape	U.R.C.	steel wire	duck tapes	
annular		slowburning	basket-weave	reinforced rubber	
segmental					

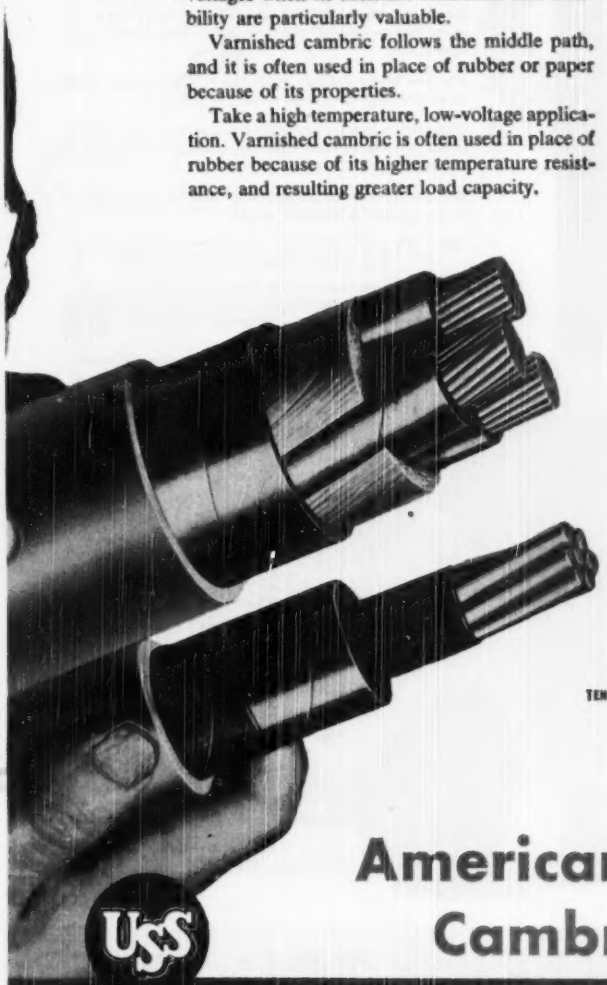
Varnished Cambric?"

APPLICATIONS

● Impregnated paper is still the standard insulation for high-voltage operation and general power transmission. And rubber is advisable for most low-voltage installations—or even higher voltages when its moisture resistance and flexibility are particularly valuable.

Varnished cambric follows the middle path, and it is often used in place of rubber or paper because of its properties.

Take a high temperature, low-voltage application. Varnished cambric is often used in place of rubber because of its higher temperature resistance, and resulting greater load capacity.



Varnished cambric is also widely used for medium-voltage (up to 5000 v) transmission lines because it is so easy to install, terminate and join. It is ideal for dry locations, and it can be used without a lead sheath because it is not subject to oil drainage.

Varnished cambric is preferred for general wiring in power stations. Typical examples are: Generator leads, insulated bus bars between oil switches, distribution transformers, etc. Oil and grease resistance of this insulation also make it useful for motor leads and transformer connections.

Perhaps the most common application of varnished cambric insulated cables and wires is for general power distribution within manufacturing plants . . . especially in heavy industries where large blocks of power are transmitted for short distances. Bridges, and other structures which require aerial cables, are often serviced with varnished cambric cables that have a rubber jacket. Rubber jackets are preferable in these locations because lead would probably be ruined by vibration.

Always remember that our engineers are willing to help you solve any wire or cable problem that you may have. And there is no obligation. Write today for Bulletin No. 6195-A "Varnished Cambric Insulated Wires and Cables."

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

American Varnished Cambric Cables

UNITED STATES STEEL

IF you're still in the dark about ***NEW***

INTERNATIONAL TRUCKS

CHECK THESE FACTS:—

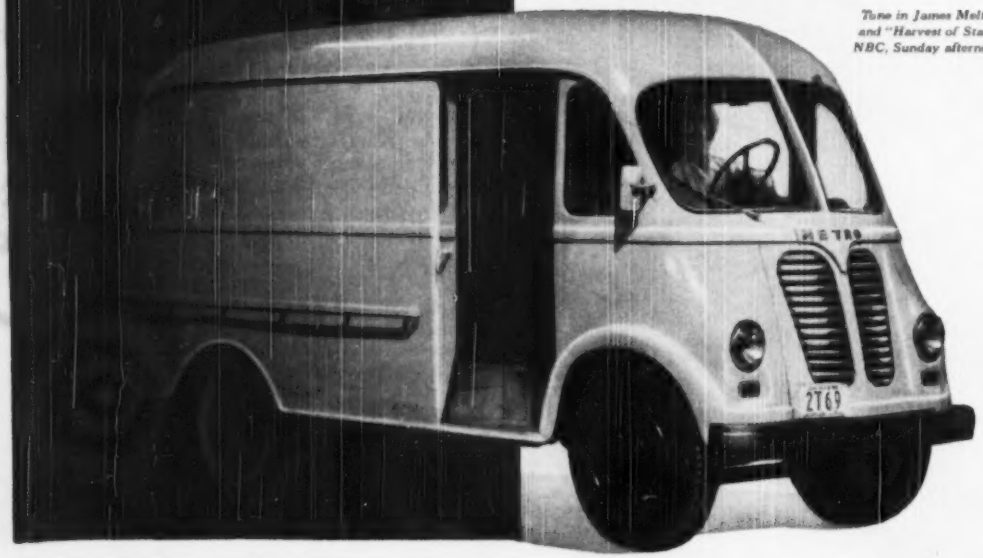
1. Every new International Truck—from the smallest to the largest—is heavy-duty engineered to save you money, with the traditional stamina that has kept Internationals first in heavy-duty truck sales for 18 straight years.
2. Every new International with Metro* body gives you greater-than-ever efficiency in multi-stop delivery truck operations.
3. Six new Metro models available. GVW ratings—5,400 to 10,000 lbs.; body sizes—7¾, 9½ and 12 ft.
4. The world's largest exclusive truck service organization is ready to keep your Internationals operating at peak efficiency.

But get *all* the facts—see your nearest International Truck Dealer or Branch, soon.

*Metro. Registered trade mark of The Metropolitan Body Company, Inc., subsidiary of the International Harvester Company.

International Harvester Builds McCormick Farm Equipment and Farmall Tractors...Motor Trucks Industrial Power...Refrigerators and Freezers

Tune in James Melton and "Harvest of Stars" NBC, Sunday afternoons



ALL NEW, ALL PROVED

INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY CHICAGO

L-M Announces

a revolutionary new development in transformer oil

protected with

ORTO

"ORTO"* brand oil is a revolutionary new inhibited oil that resists oxidation, acidification, and sludging. It lasts several times as long as a high-grade conventional oil. Therefore it offers these advantages:

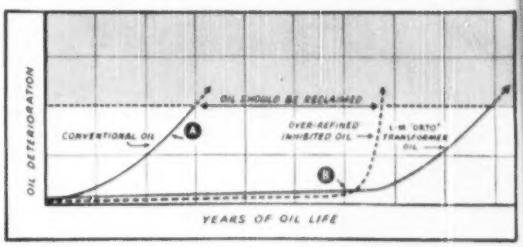
1. **Improved overload capacity**
2. **Longer transformer life**
3. **Lower maintenance costs**

"ORTO" brand oil has been thoroughly tested. Its advantages are conservatively stated. It does not deteriorate suddenly after the inhibitor has been used up. In "ORTO" the inhibitor lasts many years. After that the oil still has inherently long life, with normal resistance and characteristics; and it then simply begins the normal rate of deterioration.

All this time "ORTO" has kept cooling oil passages clear of sludge, permitting the original unrestricted oil circulation, and maintaining the original high short-time overload capacity. By preventing the formation of acids, "ORTO" has protected cellulose insulation from deterioration, and has prevented the corrosion and rust caused by acidified oil.

"ORTO" brand oil is now available exclusively in L-M Round-Wound and other L-M distribution transformers.

Ask the L-M Field Engineer for complete information, or wire or write Transformer Sales Department, Line Material Company, Zanesville, Ohio (a McGraw Electric Company Division).



Comparative curves show the deterioration of transformer oil in service. A high-grade conventional oil deteriorates at a gradually accelerating rate. Over-refined oils may have a better response to the inhibitor; but once the inhibitor has been used up, the oil has little resistance to oxidation, and deteriorates rapidly. "ORTO" brand oil is a high-grade conventional oil with an inhibitor which greatly extends the beginning of the deterioration, which, when it finally starts, assumes the same gradual curve as with *any* high-grade conventional oil.

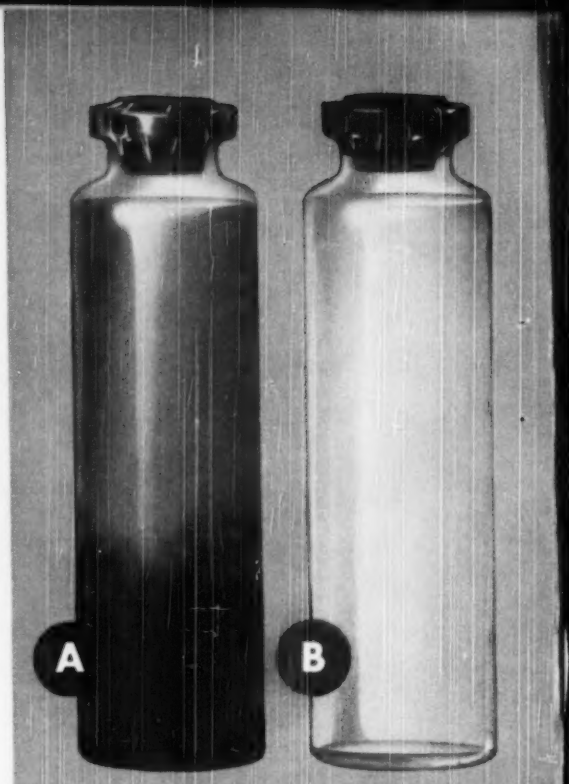
*Trademark

10-1

LINE MATERIAL... Transformers

WHAT HAPPENS TO OIL IN A TRANSFORMER

As a transformer oil is constantly heated and cooled, it tends to oxidize. In the process, various acids are formed in the oil. These acids not only hasten the process of oxidation but also contribute to the formation of insoluble substances generally known as sludge. The further the oil oxidizes, the greater the amount of acids and sludge formed, which in turn contribute to an increased rate of oxidation. So oil deterioration goes on at an accelerated rate, until finally the oil as shown in bottle **A** must be reclaimed or replaced.



Here's what two oils look like, at points A and B on the curves shown on Page 1. Bottle A is a high-grade uninhibited conventional oil which has oxidized, become acid, and sludged. It should be reclaimed or replaced. Bottle B is L-M's "ORTO" brand, after considerably longer service. It shows no deterioration, because the inhibitor is preventing oxidation and sludging.

WHAT INHIBITORS DO IN TRANSFORMER OIL

An inhibitor is a substance which, by its own nature, will prevent another substance with which it is in contact from entering into some specific change. That is, an inhibitor prevents something from happening.

In a transformer oil, our inhibitor prevents the oil from oxidizing or chemically uniting with oxygen. The inhibitor prevents the later formation of acids and sludge.

CAN BE MIXED WITH OTHER OILS

A desirable inhibitor is inert—that is, it will not readily combine chemically with other substances. Also, it should not combine with or react to other inhibitors. This is desirable in cases where one kind of inhibited oil is mixed with oil protected with a different inhibitor.

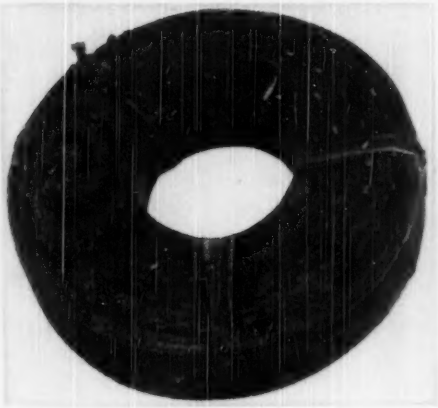
It is also desirable that an inhibitor be of a type to which the oil itself has a good response. One of the problems of the inhibitors that were generally available was that they got a good response from over-refined oils, but not from a high-grade conventional oil. The result was that when the inhibitor was eventually used up, the over-refined oil was likely to deteriorate rapidly and without warning, because the oil alone did not have the inherently long life and high resistance to oxidation that were required.

UNDER FULL L-M CONTROL

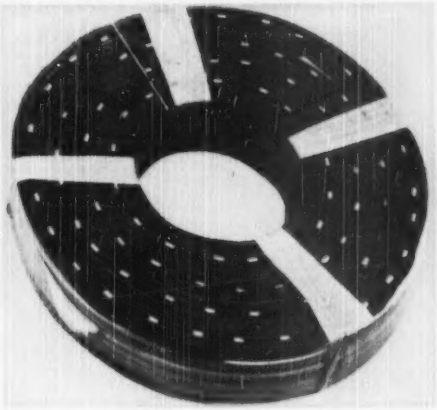
Therefore, an inhibitor should be of a type that obtains a good response with a high-grade conventional oil and which will deteriorate at only a normal rate after the inhibitor has been used up. "ORTO"* brand transformer oil is a combination of this type of inhibitor and a high-grade conventional oil which has an excellent field service record. The inhibitor is added in L-M's own laboratory, so that L-M has full control of both oil and inhibitor.

*Trademark

WHAT L-M'S NEW INHIBITOR DOES



A transformer test coil using a good grade of conventional transformer oil, after the equivalent of about eighteen years' field service. Sludge deposits from oxidized oil have clogged the oil passages. Flow of the cooling oil is greatly restricted, and coils and insulation become much hotter. Insulation deteriorates, reducing the impulse strength; capacity of the transformer to handle both high short-time overloads and long-time low-magnitude overloads is appreciably reduced.



Here is an identical transformer test coil, after operating under the same conditions for the same period of time. In this case the oil was L-M's "ORTO" brand oil. The inhibitor has prevented oxidation of the oil; there is a minimum amount of acids to damage the insulation; and there is no sludge. Oil passages are clear; oil flow is unrestricted; cooling is the same as it was when the transformer was new; initial overload capacity and impulse strength have been maintained.

WHAT L-M'S NEW INHIBITOR DOES FOR THE OIL

L-M's new inhibitor is combined in L-M's own laboratory with a high-grade, full-bodied conventional oil. It protects this oil against oxidation for many years. Thus it virtually eliminates the formation of acids and sludge, and the resultant corrosion and general deterioration.

WHAT L-M'S NEW INHIBITOR DOES FOR THE TRANSFORMER

Reliable tests that can be correlated with field service show that the inhibitor in L-M's "ORTO"* brand oil protects the transformer containing it for several times the length of service that the same transformer would give under the same conditions with an uninhibited oil.

During this period all the materials of the transformer share in this lengthening of life. By preventing the formation of acids, "ORTO" brand oil practically eliminates corrosion above the oil level.

INSULATION LASTS LONGER

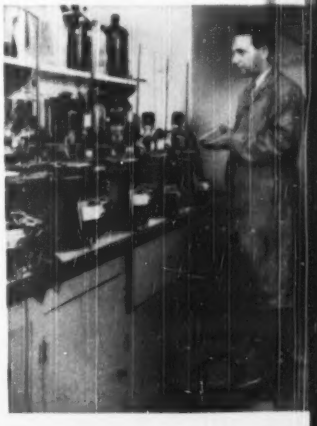
Prevention of acid formation also lengthens the life of paper and cotton insulation, which is deteriorated by both heat and acids. Thus "ORTO" maintains the high impulse strength of the transformer for a much longer period.

LONGER LIFE FOR TRANSFORMER

By preventing the formation of sludge, "ORTO" maintains the original high short-time overload capacity, and the transformer operates at lower temperatures for many more years. Transformers overloaded within the limits set by the cellulose insulation will give *longer life* when they contain "ORTO" brand oil. "ORTO" oil will greatly prolong the *initial* overload capacity, and lengthen the life of the transformer and all its componenta as well.

NEW ACCELERATED TEST

Martin I. Zwelling, Chief Laboratory Engineer, inspects one of the test stands in L-M's Transformer Division Research Laboratory. Here L-M engineers and technicians not only carried on much of the research that developed "ORTO"* brand oil, but also developed a revolutionary new method of accelerated tests that coordinate very closely with results in actual field service.



*Trademark

ROUND WOUND

COILS

CORE

REG. U.S. PAT. OFF.

protected with

ORTO

GET THE ADVANTAGES OF L-M ROUND-WOUND TRANSFORMERS ... NOW EVEN GREATER WITH "ORTO"* OIL

Among the many advantages of L-M's exclusive Round-Wound design are high short-time overload capacity, high impulse strength, and long life for the transformer, with low maintenance and low operating costs.

These advantages have been outstanding, even in L-M Round-Wound transformers using high-grade conventional oils.

Today, L-M Round-Wounds (and other L-M distribution transformers) are supplied filled with "ORTO" brand oil. Because it is a high-grade inhibited oil, "ORTO" greatly enhances the advantages inherent in the Round-Wound design. Because "ORTO" maintains its original condition for many years, the transformer itself maintains its initial high overload capacity for a much longer time.

Because the oil is kept free from acids, insulation is not subject to deterioration by oil acids; and the transformer maintains its high impulse strength for a far longer period.

Because all parts of the transformer share in the long life, maintenance costs are lower, and operating costs remain at a low level for a much longer period. Thus with "ORTO" brand oil, L-M Round-Wound transformers offer an even greater return on the investment to their users.

look for the Green Shield!

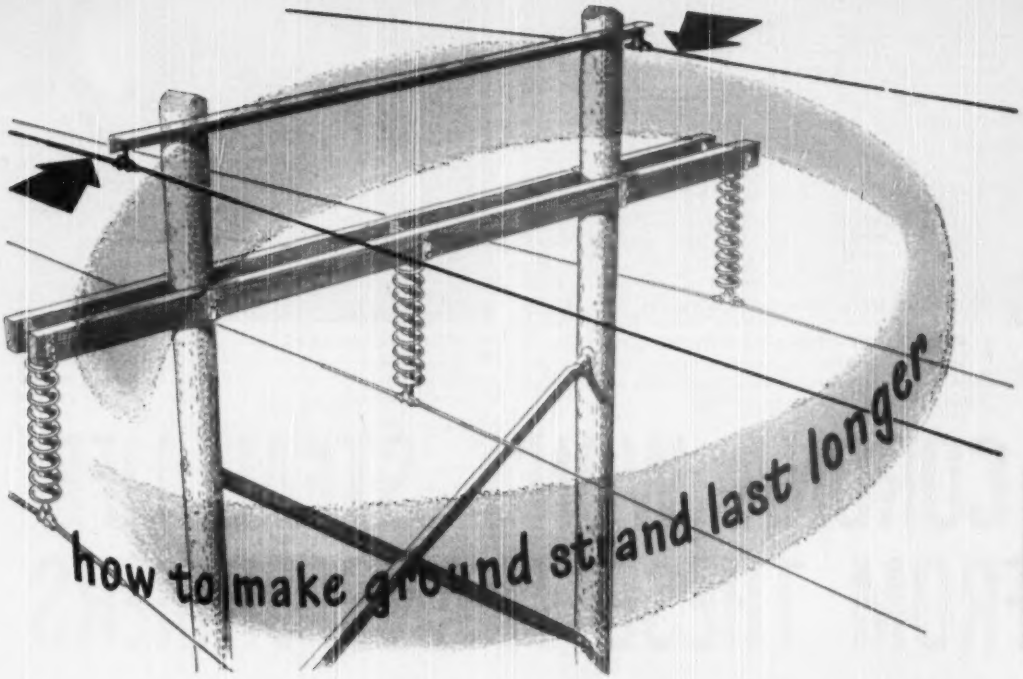
L-M distribution transformers with "ORTO" brand oil are available in conventional, Completely Self-Protected, subway, and dry types, single-phase and three-phase units. For information ask the L-M Field Engineer, or write Line Material Company, Transformer Sales Department, Zanesville, Ohio (a McGraw Electric Company Division).

*Trademark

LM

10-4

LINE MATERIAL ... Transformers



● Unprotected ground strand (static wire) that has been in service for as little as a year, may fail at support points. That's where the bending stresses of vibration are concentrated. That's where unbalanced line tension and abrasion take their toll.

If your ground strand is in poor condition, Preformed Armor Rods afford the most economical method of making needed repairs and extending strand life indefinitely. Any lineman, regardless of his skill, installs PLP Armor Rods without tools, clips or clamps.

Every installation is perfect. The rods are machine-formed to fit the specific conductor size. That's why they grip tighter, more uniformly over the entire strand length . . . form a tight-fitting sheath that protects the strand from clamp pressure, arc-over, burning, pitting and concentrated stresses of vibration. Where one or more wires are broken, PLP Armor Rods restore the *original mechanical and electrical properties* to the strand.

Naturally, it's wise to install PLP Armor Rods on new ground strand before damage can occur. *And for that matter, more and more utilities now protect main conductors with PLP Armor Rods.*

Why not get the whole story now? For complete information, photographs and technical consultation, write PREFORMED LINE PRODUCTS COMPANY, 1051 Power Avenue, Cleveland 14, Ohio.

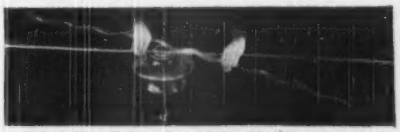
PREFORMED

Preformed armor rods are for use under patent No. 2,273,019 —other patents pending.

PLP LINE PRODUCTS CO.

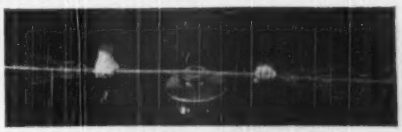
1051 POWER AVE. • CLEVELAND 14, OHIO

FOLLOW THESE SIMPLE INSTRUCTIONS



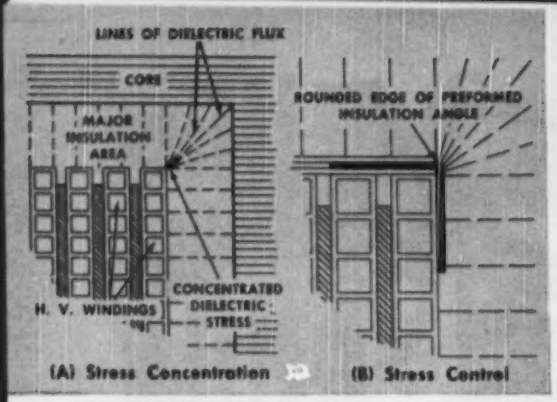
Take half to all the rods needed and lay them across and around the conductor. For splices and/or repair, apply first "half set".

Wrap around conductor several times . . . like wringing water from a cloth. Apply remainder of rods or second "half set".

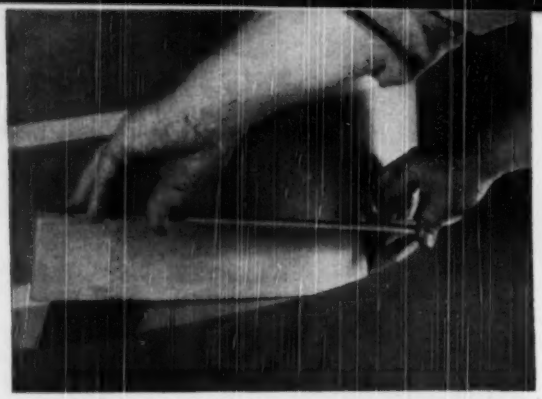


Continue wiping action along conductor.

The finished job.



1 **PRINCIPLE OF FITTING INSULATION** right up next to areas of high dielectric stress, then reducing stress per unit area with rounded surfaces, is one of the methods used by Allis-Chalmers engineers to cut corona discharge.



2 **PREFORMED INSULATION** angles are fitted snugly against coils. This eliminates voids in critical regions and reduces concentration of dielectric forces to prevent corona formation. Die-forming of these angles on electronic heater insures exact fit, eliminates air pockets in insulation.

CORONA WON'T STEAL LIFE FROM THESE TRANSFORMERS

Transformers at Central Illinois Public Service Company Tell Story of Surge-Protected Insulation

WHAT MAKES a transformer grow old? One of the chief causes is internal corona discharge — an invisible hazard that can only be detected by accurate readings of cathode ray oscillograms. The presence of corona during operating surges *scores* insulation and causes gradual weakening of transformer impulse strength.

The complete solution to this problem is announced in the Allis-Chalmers corona-free design. By a combination of improvements, *all measurable effects of corona have been eliminated* — including effects that were not even detectable until recent years!

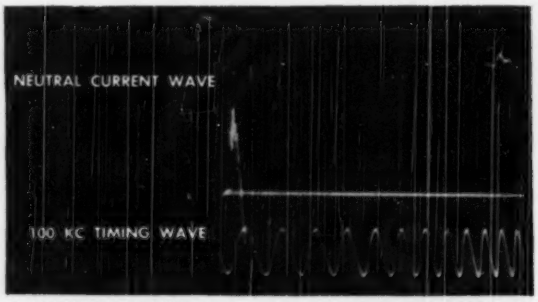
Insulation was moved right next to high voltage conductors, replacing "free space" with corona-resisting material in critical areas. Vulnerable parts of terminal boards were rounded and shielded to eliminate sharp contours. Dielectric fields were redirected, spacers redesigned and new materials used to completely "knock out" injurious corona.

Protected by this design, Allis-Chalmers power transformers will retain their full impulse strength after repeated surges or switching.

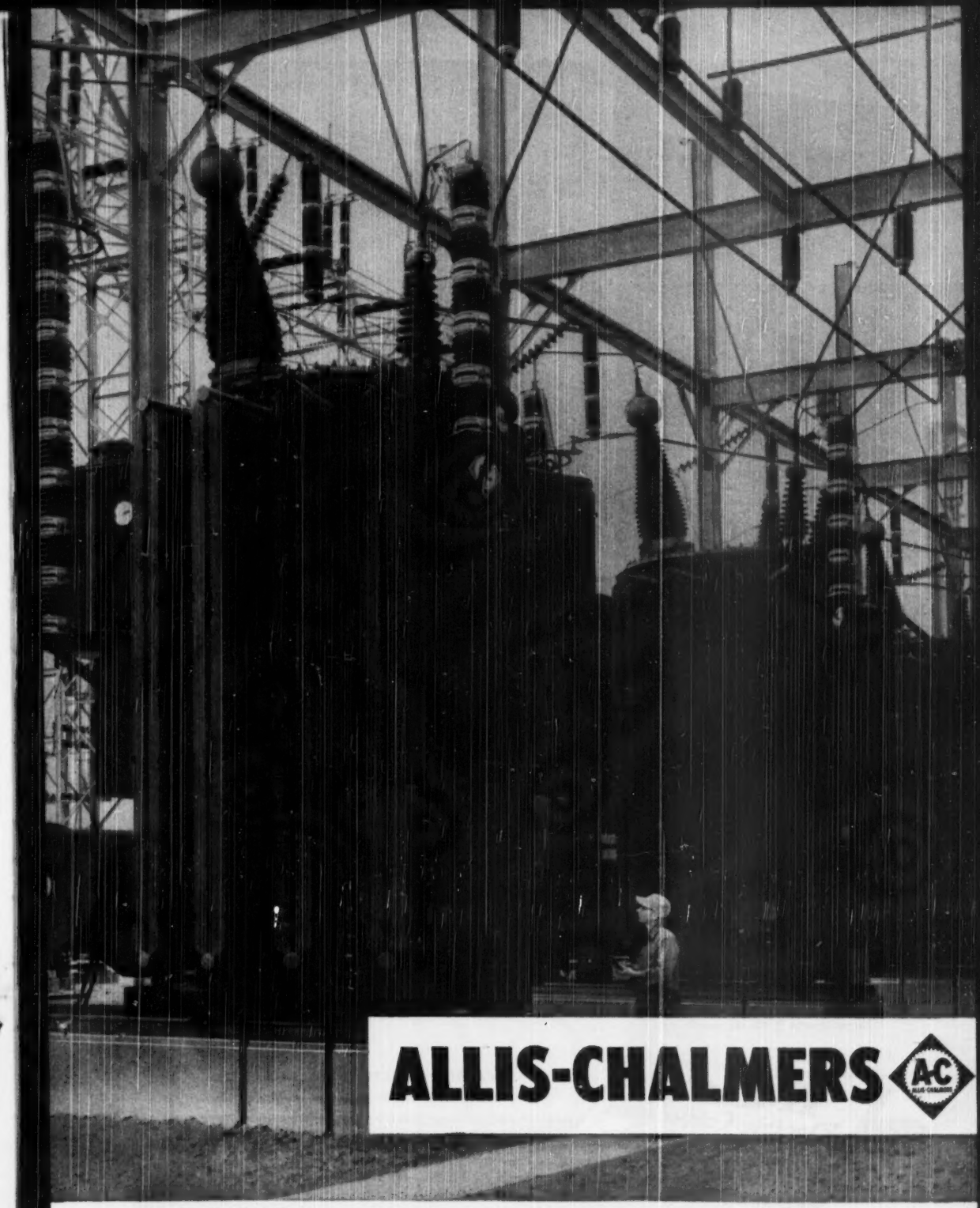
To the nation's electric power producers — like Central Illinois Public Service Company, purchaser of the transformer pictured here — this design will mean greater operating confidence, more reliable service, and full return on invested capital. A-3092

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

3 **ROUNDED SHIELDS** distribute electrostatic flux around tap changer contacts to stop corona. Spacers between contacts and panel control dielectric stress between contacts, permit more compact assembly.

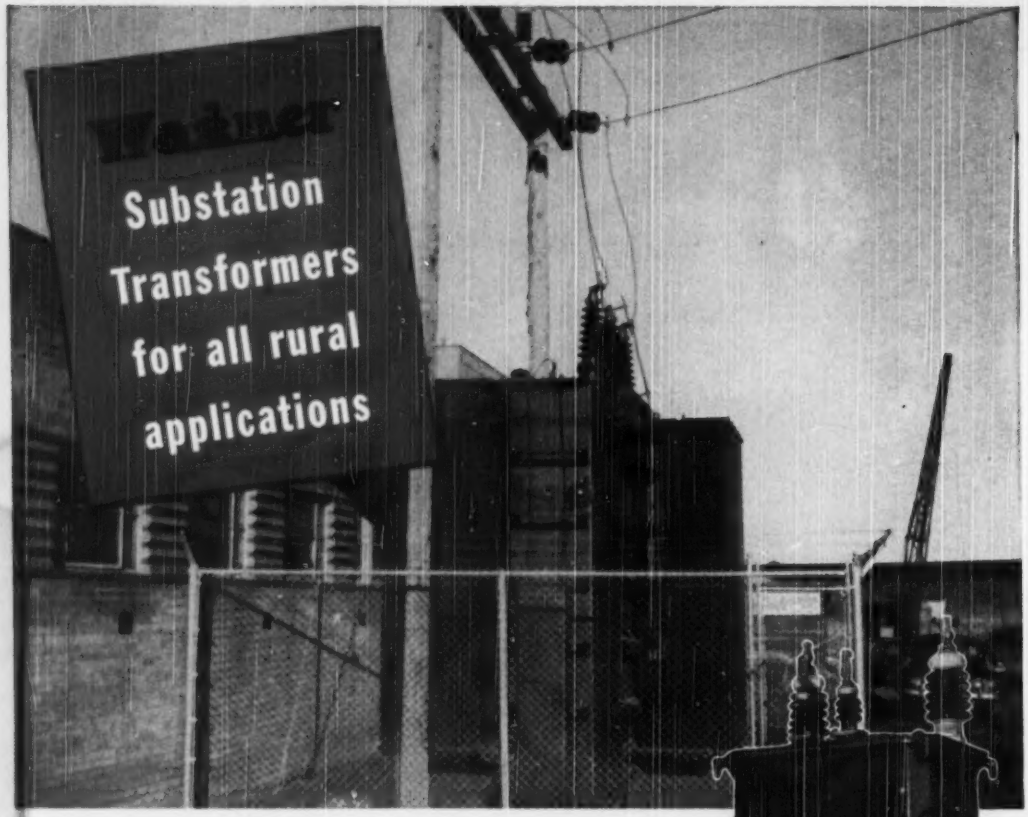


4 **EVEN THE SMALLEST** corona effect—smaller than that which could harm transformers in years of operation — can be detected with new oscillographic test techniques. Above is sample oscillogram taken during a transformer impulse test. Analysis of many such curves, taken under varying conditions, showed "no detectable corona discharge whatsoever" at over five times normal operating voltage.



ALLIS-CHALMERS

5 TO FURTHER PROTECT against surges, high and low voltage lightning arresters are mounted directly on transformers, close to the bushings. *Oil-Sealed* Inert Gas expansion tanks are mounted on side of transformers, near the ground, to increase overhead line clearances. Installed bank is rated 35,000/45,000 kva, 138 to 69 kv; equipped with ± 10% load ratio control



Wagner Transformers are the first choice of numerous rural line systems throughout the country. Power transformers for generating plants, substation transformers for feeding rural distribution lines, and thousands of pole type transformers along the lines all uphold the Wagner reputation for long life and trouble-free performance—a reputation backed by service records from the field and by six decades of transformer manufacturing experience.

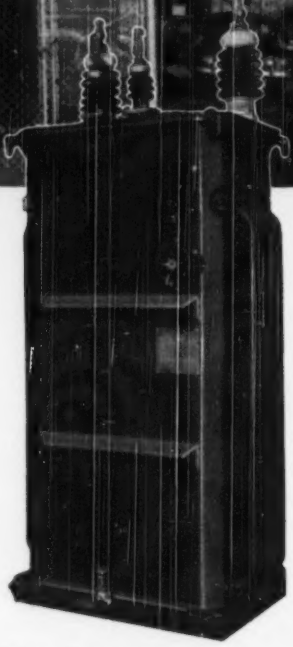
* * *

The photograph above shows a 7500 kva type HPW three-phase Wagner Power Transformer in the substation of the Minnkota Power Cooperative, a generating co-op that furnishes power to ten distribution co-ops.

At right is pictured a typical 333 kva, type HEL single-phase Wagner Substation Transformer . . . transformers like these are serving dependably on hundreds of rural line systems.

If you are planning increased system capacity investigate the advantages of Wagner Substation Transformers. They are available in all standard kva and voltage ratings with standard accessories.

Bulletins TU-180 and TU-181 give full information on Wagner Substation Transformers. Write for your copies.



Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

AN INSULATOR SUCCESS STORY BUILT ON INSULATOR FAILURES

If conventional transmission insulators gave no trouble, there'd be no need for a better insulator design. But the fact is that a pin-type transmission insulator is a device which leaves considerable to be desired in the way of mechanical and electrical performance.

If you think that pin-type transmission insulators on your systems are serving "about as well as could be expected," you owe it to your company to take a good long careful look at your own maintenance records. We bet you'll find that the total annual cost for pin-type insulator replacements adds up to a mighty important piece of money.

The success of the Lapp Line Post insulator is built squarely on the fact that so many conventional pin-type insulators do fail, and the fact that use of this *better* insulator does cut maintenance cost in insulator replacements to a small fraction of that for conventional insulators.

We invite you to consider Lapp Line Posts as your transmission insulator standard—on this straight dollars-and-cents basis.

Installation Techniques are "Pay-off"...

With modern operating temperatures ranging as high as 1050°F. and pressures climbing upwards of 2,000 psig., welding and concurrent heat treating of alloy power piping *during installation* pose critical problems for field crews.

For example, the weld shown in the illustration required a heat treating cycle of over 15 hours. During this time Kellogg crews, using special induction heating equipment, raised the temperature of the weld area at a predetermined controlled rate over a period of some four hours. Upon reaching the proper pre-heat temperature, welding was started as shown in the picture.

As the weld was made the temperature was naturally held at a uniform level. Upon completion, the weld was stress-relieved at a predetermined elevated temperature for over two hours and then allowed to cool at a controlled rate for four hours to complete the cycle.

Over the years such special techniques in connection with welding alloy piping have been developed by Kellogg engineers, who have been entrusted with such recent innovations in power piping as the first HT-HP stainless steel installation and the fabrication of piping for the original 1050°F. station.

The experience of these well-trained field installation crews is one "plus value" obtained when power piping by M. W. Kellogg is specified.

Illustrated—Inspector checks laying of first bead.

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

M. W. KELLOGG

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

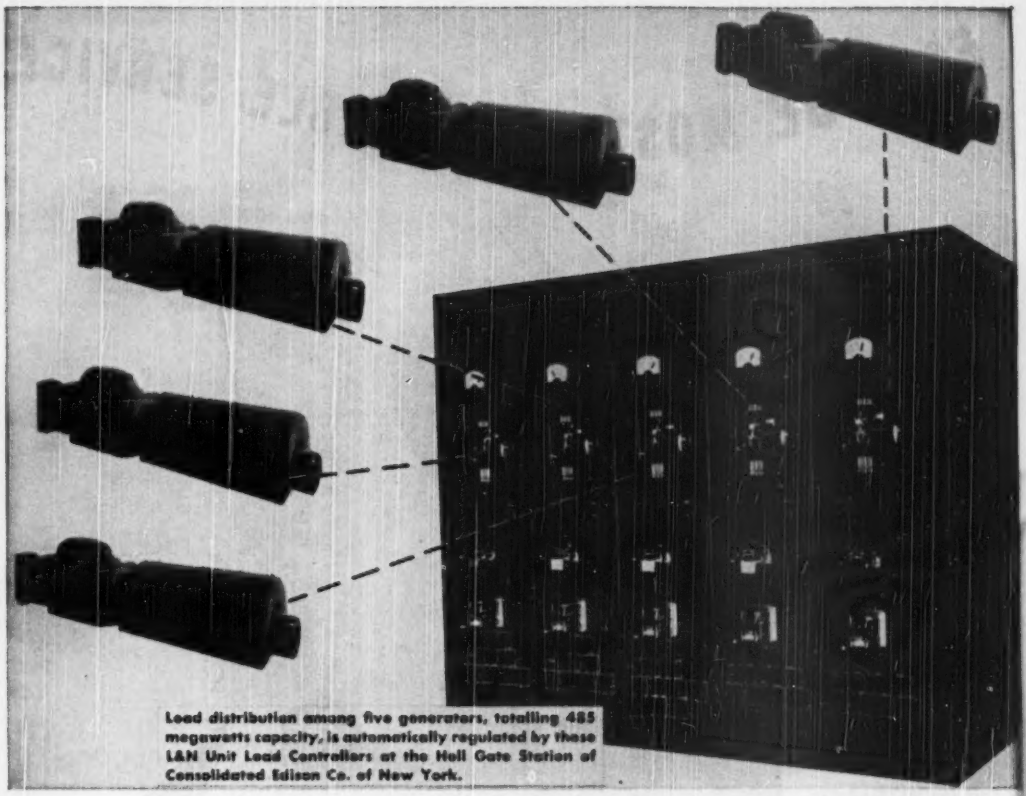
Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Vessels
Exchangers
Condensers
Process Piping
Forged and Welded Fittings
Radial Brick Chimneys

★

The M. W. Kellog Company, Inc. Sub. of Pullman Incorporated—Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.



Load distribution among five generators, totalling 485 megawatts capacity, is automatically regulated by these L&N Unit Load Controllers at the Hell Gate Station of Consolidated Edison Co. of New York.

"Load Dispatcher" for each unit cuts generation costs

Changes in power demand necessarily mean changes or swings in the amount of power generated—and often affect the cost of producing power. One of the best ways to cut these costs is to spread the load swings among as many generators as possible. Then when load varies, each generator contributes only a relatively small share of the change, and thus can stay at steadier output, close to its own range of best efficiency. In other words, planned distribution reaches a firmer basis all the way down to the individual generators.

The complexity and tediousness of manual load distribution are eliminated in many plants by having this work done automatically through L&N Unit Load Control. Each L&N Controller acts, in effect, as a "load dispatcher" for its own generator. It watches the total load on the station, and when a change comes along, it tells its generator how much of the change to take. The percent of total load assigned to each generator can be varied readily at the operator's discretion, by means of suitable dials. Quickly and efficiently, he can adjust the whole station's generating picture to handle economically any load situation which may arise.

L&N Unit Load Control works with your existing load-frequency control equipment, and can be applied to practically any generating unit. For details, write to Leeds & Northrup Company, 4938 Stenton Avenue, Philadelphia 44, Pennsylvania.

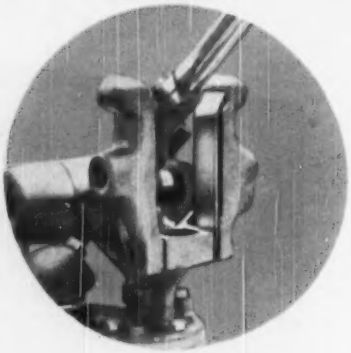
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl Ad ND44-56-461(2)

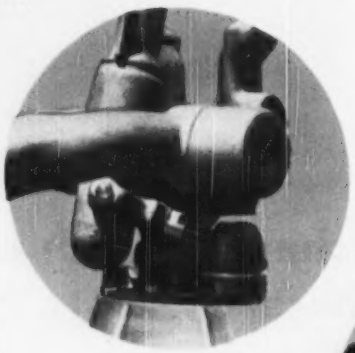
FOR THE MOST DEPENDABLE SERVICE

*Available in all standard NEMA ratings from 7.5 KV to 230 KV, and in current ratings from 400 amp. to 6000 amp.



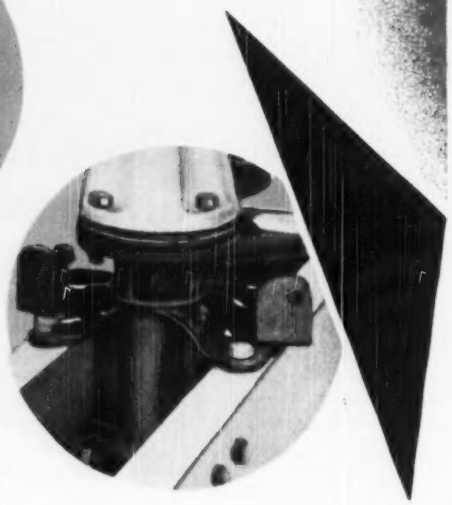
CONTACTS

Jaw and blade contacts are identical. Stationary contacts for 400 and 600 amp. switches rated 69 KV and below are of Beryllium copper. Stationary contacts for all other ratings are of bus copper, enclosed in cast bronze housings with stainless steel backup springs. Contacts for all high current ratings are provided with bar silver contact surfaces brazed to the bus copper contacts.



SIMPLE MECHANICAL LINKAGE

The Type WAG is constructed with only four moving elements. Extremely high blade torque allows wide contact deflection under unusually high pressure. Universal link and ball joint provide smooth blade control without jerking. No rolling or sliding members are used in the mechanism. Sleet shield removed to show linkage.

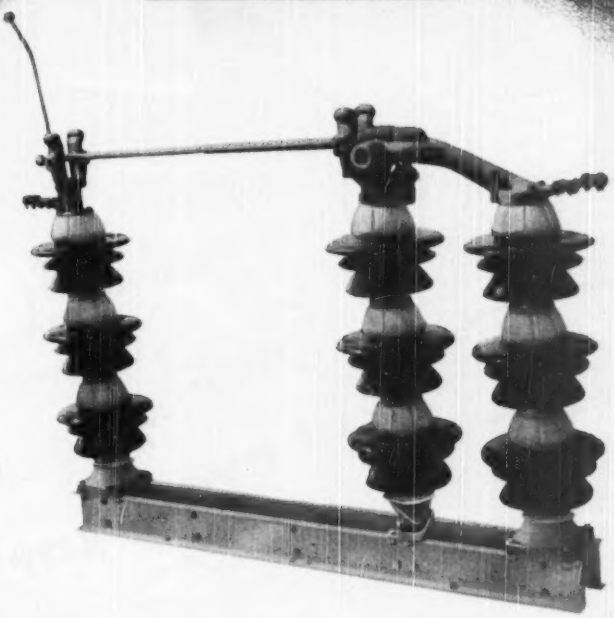


GREASELESS BEARINGS

No maintenance is required for the oilite or greaseless bearings in the Type WAG. Double race greaseless ball bearings are used at the top and bottom of the rotating insulator.

The Type WAG switch is available for horizontal upright, vertical or underhung mounting. Torsional type stainless steel balancing springs are provided in all ratings where blade moment is sufficiently high to require counterbalancing.

. . . THE TYPE WAG*



The SS Type WAG high pressure switch represents the finest device in its field both in engineering design and quality of manufacture. It tops them all (1) for dependability of mechanical action: (2) in adequate electrical capacity: (3) ease of operation: (4) ease of installation and adjustment: (5) freedom from maintenance, and (6) in blade torque for ice breaking action.

Southern States Equipment Corp.

HAMPTON GEORGIA

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Same high quality
in every car!
U·S·S Creosote Oil is constant in quality from order to order. That's because production is continuous at the world's largest tar distillation plant where U·S·S Creosote Oil is made . . . there's no chance for batch-to-batch variation. As a result, you can always expect the same excellent results from treatment with U·S·S Creosote Oil. You can predict accurately the savings in replacement costs made possible by the extra life U·S·S Creosote Oil adds to wood. For more information on the advantages of U·S·S Creosote Oil, contact the nearest sales office listed below.
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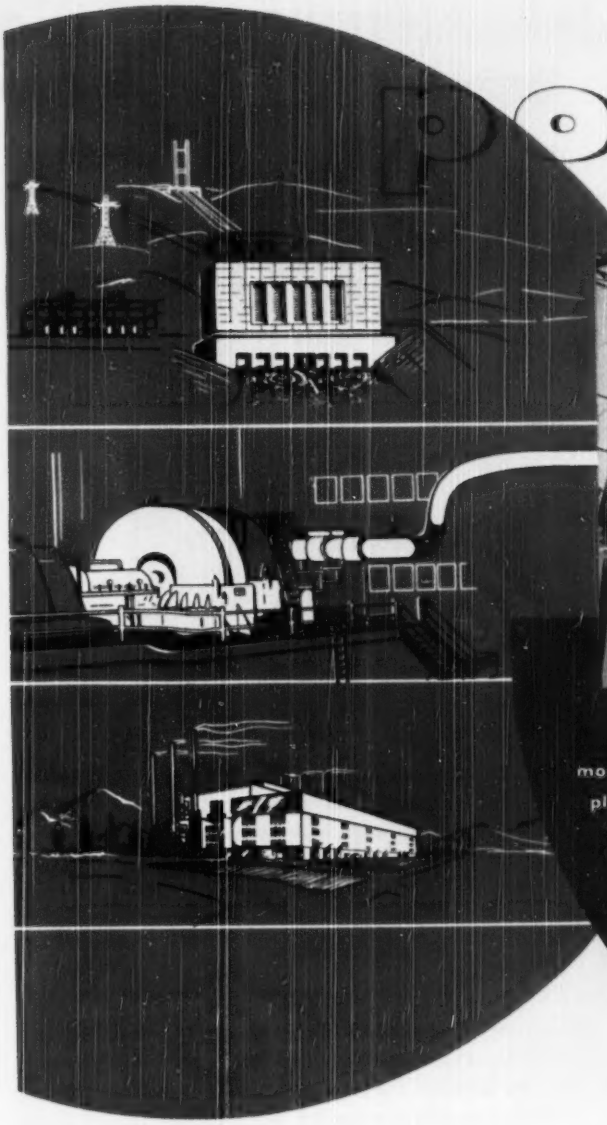
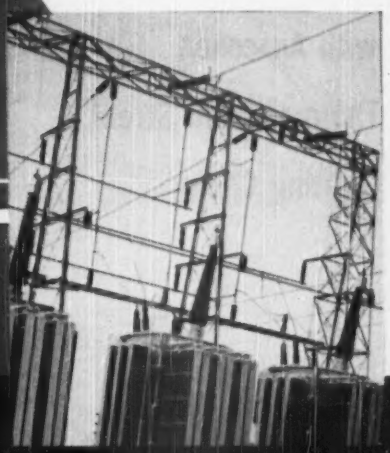
Power





Whether electricity starts in the mountains or flows from a lowland steam plant—Bechtel can design and build the facility required. Bechtel Corporation is playing a major role in engineering and constructing giant power projects and enlarging existing utility and industrial installations to handle millions of new horse power load.

BECHTEL

BECHTEL CORPORATION

Los Angeles • SAN FRANCISCO • *New York*
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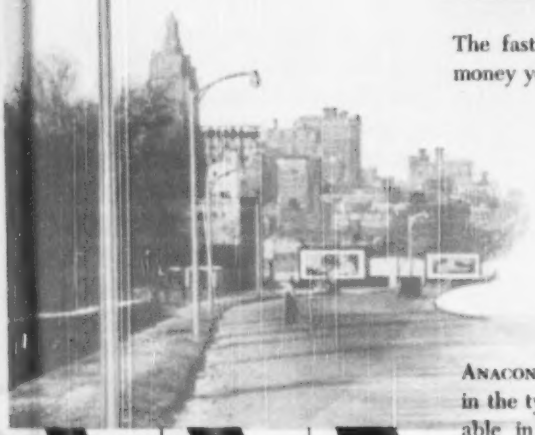
"BUILDERS FOR INDUSTRY"

DESIGN • ENGINEERING • CONSTRUCTION

You get both speed and economy with ANACONDA Thermoplastic Street Lighting Cable

time elapsed: ½ hour

The faster you install a street lighting cable, the more money you save and the happier it keeps the public.



Here's why ANACONDA Thermoplastic Street Lighting Cable lends itself to streamlined installation with simple equipment:

It's light and easy to handle.

Polyethylene insulation reduces O. D.

It's easy to splice.

It's more economical to buy and use.

ANACONDA Thermoplastic Series Lighting Cable is supplied in the types shown—3000 v and 5000 v service. Also available in metallic shielded and jacketed construction or with lead sheath, as required. Let your nearby Anaconda Sales Office or Anaconda Distributor tell you all about it. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

1/c solid polyethylene or Densheath* insulation. No jacket.

1/c solid polyethylene—insulation plus FR* or Densheath jacket.

2/c stranded pole and bracket cable with rubber insulation and belt.

Densheath is a vinyl resin, thermoplastic. FR is a flame retardant thermoplastic compound based on polyethylene.

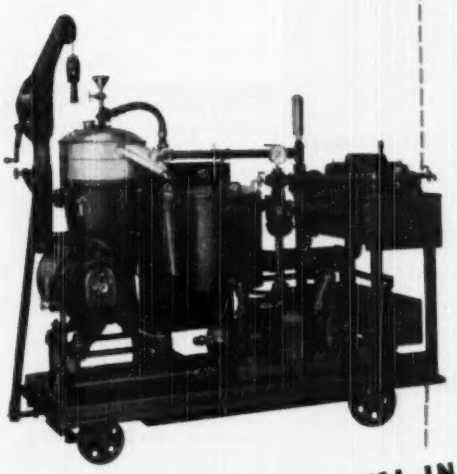
*Reg. U. S. Pat. Off.

The right cable for the job ANACONDA®

WIRE AND CABLE

Restore The Dielectric • • •
with the

DE LAVAL PORTABLE
Insulating Oil Purification Outfit



The higher purifying efficiency and higher daily capacity of De Laval Insulating Oil Purifiers are two reasons why they are used by most of America's largest power systems.

These two advantages result in greater protection for transformers and circuit breakers, because they make it possible to economically maintain oil at a higher dielectric value.

De Laval Insulating Oil Purifiers require a minimum of attention and operate over long runs at top efficiency and capacity. Water is continuously discharged. No water can collect in the bowl of the centrifugal machine to make the Purifier suddenly ineffective. De Laval purification is safe and it is positive.

ADVANTAGES OF DE LAVAL INSULATING OIL PURIFIERS
Dehydrates at a single pass—no re-running
Higher daily capacity of purifier saves maintenance costs
More economical to operate
Heater cannot carbonize the oil

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

INSULATING OIL PURIFIERS

READ WHAT USERS SAY ABOUT

G.E.'s New All-Purpose* Insulating Varnish G-E 9574

J. L. Hughes, owner of the J. L. Hughes Electric Company, Columbus, Ohio, says:

"We have found from test and practical experience that General Electric general-purpose varnish 9574 is tops for our work."

J. Lindborg, owner of AAA Electric Motor Service, Atlanta, Ga., says:

"Our experience has been that this varnish is as good as G.E. claims. It gives a good coat on every type of wire, bakes easily and dries to a tough coating that stands up perfectly in service."

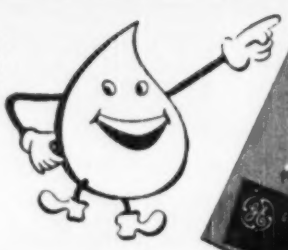
Guy W. Probst, owner of Lockhaven Electric Repair Co., Lockhaven, Pa., says:

"I find that I only use about half as much 1201 Glyptal as a cover coat on 9574 as I had to use over the varnish I had been using, and I get higher gloss and better bonding."

These statements indicate the success of the new G-E 9574. If you are looking for an insulating varnish which bakes at low temperatures, penetrates deep coils easily, and requires no special thinner, investigate G-E 9574.

**G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G.E.'s complete line of electrical insulating materials, including wedges, adhesives, cements, compounds, cords and twines, sleeving, wire enamels, mica, papers and fibers, permafils, tapes, tubing, varnished cloths, and varnishes.*

Here's A Bulletin You Should Have! If you haven't yet tried G-E 9574 get in touch with your local G-E Distributor, or write for our new bulletin to Section K3, Chemical Department, General Electric Company, Pittsfield, Massachusetts.



You, too, can put your confidence in

GENERAL ELECTRIC

The RCA Carfone 152-174 Mc.

More than meets all FCC requirements

Complete with loudspeaker, controls, microphone, antenna, and self-contained transmitter, receiver, and power supply.

Better service over wider area

Carfone systems reduce adjacent-channel interference to the vanishing point. "A" is area for reliable operation using Carfone. "B" is area using conventional type equipment.

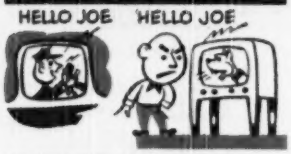
Holds voice level constant

Transducer modulation control holds modulated output *constant*, whether you shout or whisper into "mike." Does not "crowd" other channels. More than meets FCC rules.

Makes mounting easy

"Sandwich Case" construction makes installation easy—even in the "tight" spots. No mounting brackets needed to raise a CARFONE for servicing.

Suppresses "unwanted" radiation



Spurious emission way down on *all* frequencies—not just in the band. More than meets FCC rules for reducing interference with other services.

Bars interference

Low spurious response in CARFONE receiver does away with interference from transmitters on other frequencies.

Why you will prefer the RCA CARFONE

BECAUSE the RCA CARFONE enables systems cars and trucks to operate *without interference* over greater geographical area than was heretofore believed possible.

BECAUSE the RCA CARFONE can be installed almost anywhere. In passenger vehicles it can be installed on the fire wall . . . or on the shelf behind the back seat . . . or in the rear deck. In trucks it can be mounted on the wall of the driver's compartment, in the freight section, in truck side lockers.

BECAUSE the RCA CARFONE requires no extra space for opening sliding drawers—requires no double mountings—uses no junction boxes.

For complete details . . . or for consulting help on your radio system . . . write Dept. 31G. No obligation, of course.

MOBILE COMMUNICATIONS SECTION
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

BH "649"

New Technical Data

and Samples for Test

Get this folder on BH "649"—it's packed with technical information about the toughest insulation we have ever made. Tells how BH "649" resists severe abrasion—retains rated dielectric strength under constant vibration, excessive current load—stays supple after baking 24 hours at 302°F.

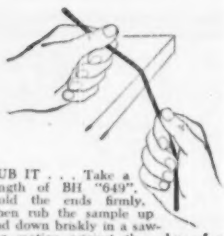
It tells how BH "649" endures high operating temperatures without impairing its physical and electrical properties and how it withstands sub-zero temperatures.

It shows some of the many applications for this outstanding insulation—products and equipment in which BH "649" is being used.

It gives important technical data on the resistance of BH "649" to vapors, oils and chemicals. It includes three 4" samples of Grade "A-1" Tubing—for production samples give us details about your requirements.

BENTLEY, HARRIS MANUFACTURING CO., CONSHOHOCKEN, PA.

KNOT IT . . . Take a length of BH "649". Knot it. Pull it as tight as you can. Twist it. Then loosen the knot. There is no cracking. No change in the dielectric strength.



RUB IT . . . Take a length of BH "649". Hold the ends firmly. Then rub the sample up and down briskly in a sawing motion against the edge of a desk or chair. See how difficult it is to damage the coating.

HOLD A MATCH UNDER IT . . . Take a length of BH "649". Hold a lighted match under it. BH "649" will not support combustion.

BH *Fiberglas** SLEEVINGS

USE COUPON NOW

Bentley, Harris Mfg. Co., Dept. W-7, Conshohocken, Pa.

I am interested in BH "649" Fiberglas Tubing and Sleeving. Send Technical Data Folder.

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Send samples, pamphlets and prices on other BH Products as follows:

☐ BH non-fraying Fiberglas Sleeving

☐ Cotton or Rayon-base Sleeving and Tubing

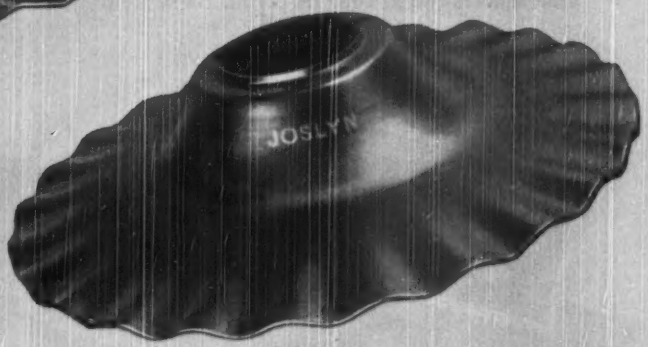
Joslyn leads again —

STAINLESS STEEL RADIAL BOWL REFLECTORS

PERMANENT!

RUGGED!

AVAILABLE!



1. 20-inch Type 18-8 Stainless Steel Radial Bowl Reflector for open Street Lighting Luminaires.
2. Resists corrosion.
3. Extremely durable.
4. Long life.
5. Ideal for salty atmospheres, industrial areas, or conventional installations.
6. No enameled surfaces to chip.
7. Easy to clean.
8. Attractive appearance.
9. Fits standard street heads.
10. Low cost.
11. Available now from stock.

BE MODERN! Use this up-to-date Stainless Steel Reflector for your radial bowl requirements—Save maintenance and replacement expenses—

Branch offices in principal cities

THE JOSLYN CO.
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Complete Pole Line Equipment

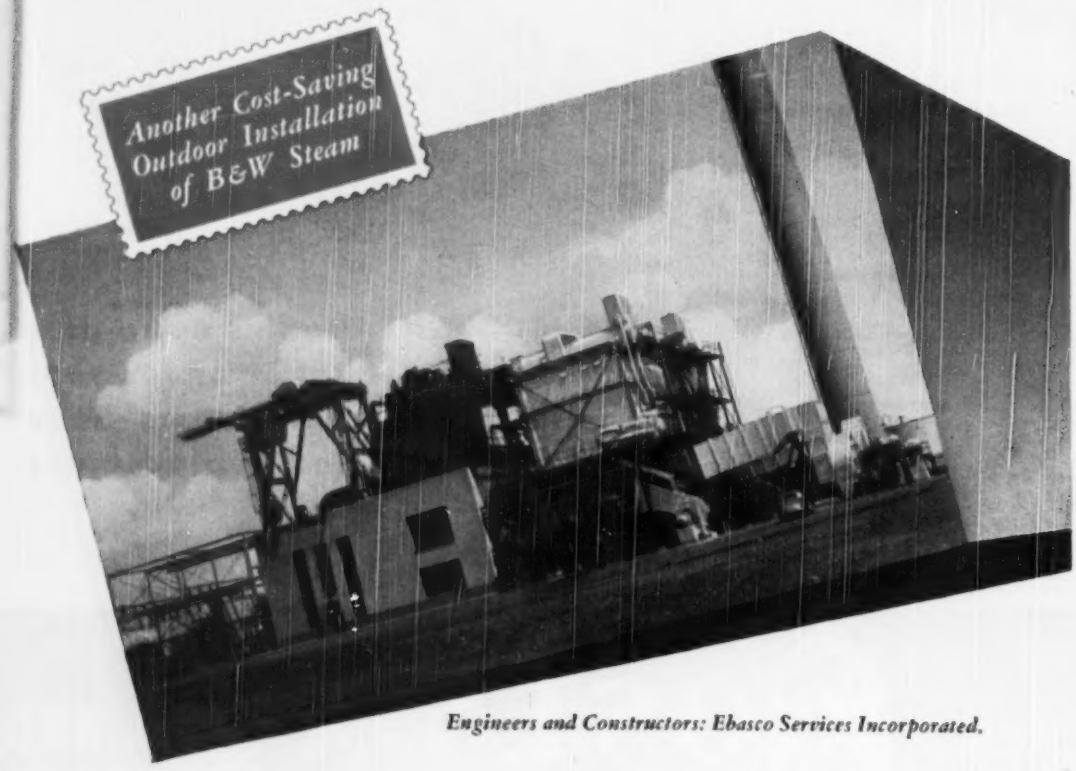
20 NORTH WACKER DRIVE, CHICAGO 6, ILL.

"Fresh Air" boilers aid

OF NEW HANDLEY STATION

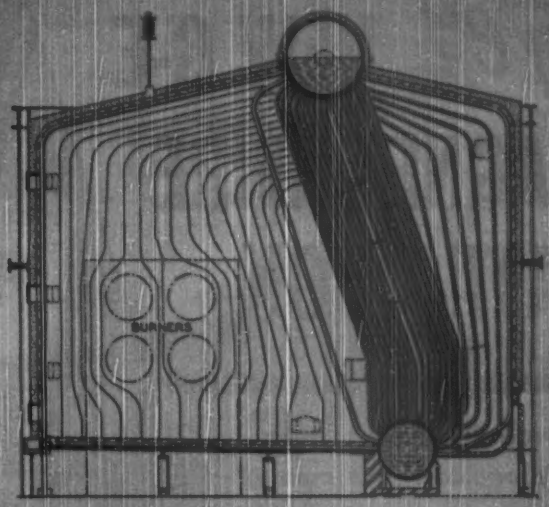
Incorporating the latest advances in simplification of steam electric plants, New Handley Station of Texas Electric Service Company, Fort Worth, Texas, is a good example of the initial economies afforded by outdoor construction. Here, not only the boilers but also the turbo-generator, condenser, fans, and various other auxiliaries are in the open. Supplying steam requirements for a 43,750-kw turbo-generator are two 215,000 lb. per hr. B&W Integral-Furnace Boilers, as illustrated.

An increasing number of power companies are finding the B&W Integral-Furnace Boiler the best buy for steam requirements up to 350,000 pounds per hour, and for outdoor as well as conventional installations. Complete description of this popular boiler unit is available in bulletin G-38. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

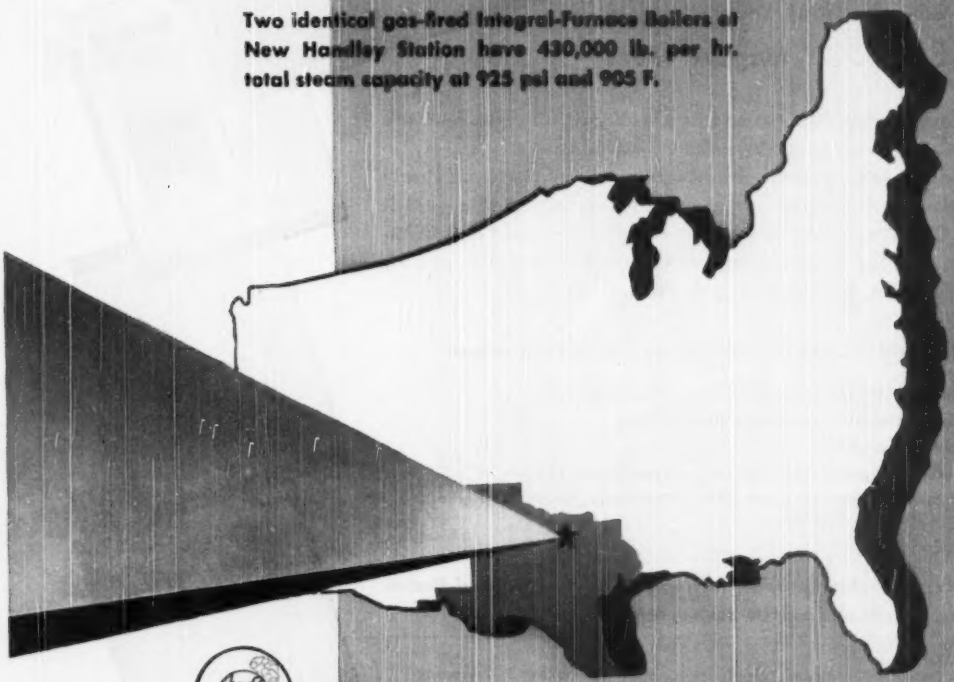


Engineers and Constructors: Ebasco Services Incorporated.

economy

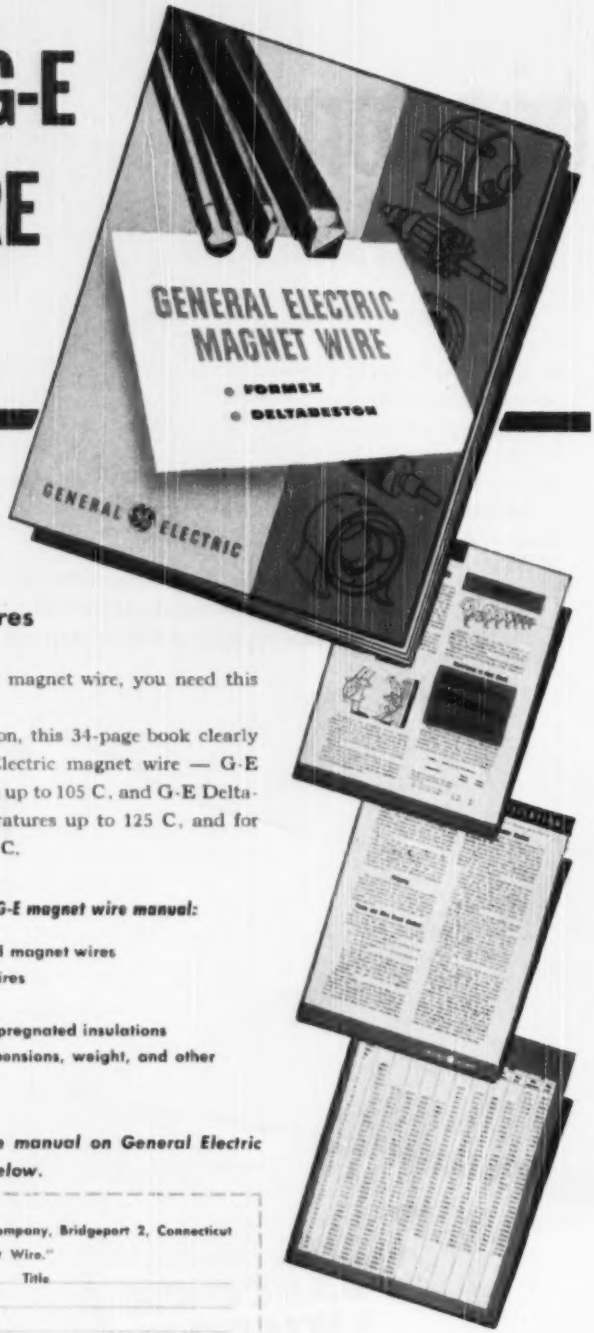


Two identical gas-fired Integral-Furnace Boilers at New Handley Station have 430,000 lb. per hr. total steam capacity at 925 psi and 905 F.



BABCOCK & WILCOX

Free NEW G-E MAGNET WIRE DATA BOOK



Now for the first time in one complete manual

FORMEX® Magnet Wires

DELTABESTON® Magnet Wires

For jobs involving specifications and uses of magnet wire, you need this new General Electric magnet wire manual.

Packed with helpful, hard-to-get information, this 34-page book clearly and concisely covers all types of General Electric magnet wire — G-E Formex for Class A applications, temperatures up to 105 C, and G-E Deltabeston, both for Class B applications, temperatures up to 125 C, and for Class H applications, temperatures up to 180 C.

Here are just a few of the subjects covered by the G-E magnet wire manual:

- **Properties of enamel- and asbestos-insulated magnet wires**
- **Tables of types and sizes of stock magnet wires**
- **Application procedures**
- **Information on special glass and silicone-impregnated insulations**
- **Tables covering electrical specifications, dimensions, weight, and other pertinent specification data**

To get your copy of this fact-filled reference manual on General Electric magnet wires, just clip and mail the coupon below.

Section W13-727
Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut

Please send me free copy of "General Electric Magnet Wire."

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

GENERAL ELECTRIC

No other stationary battery equals the Gould Planté. These batteries practically last forever! Many are still in active, full-float service after 20, 30, even 40 years!

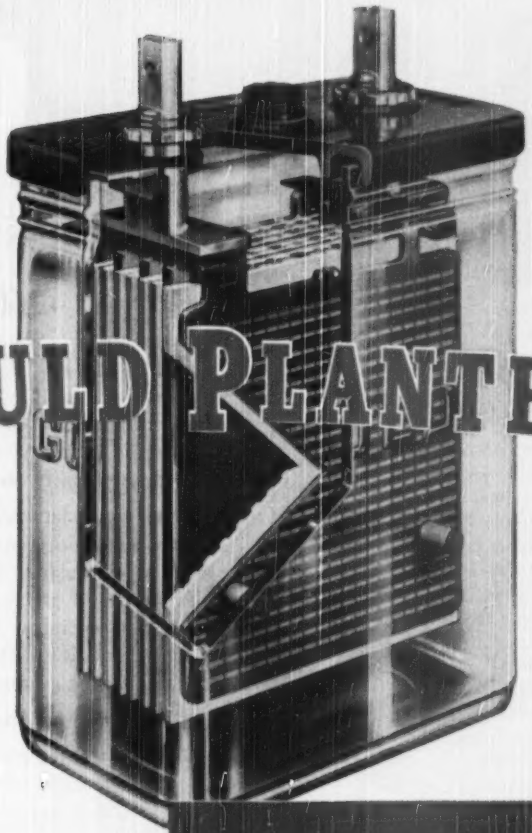
Such service means that their per annum cost is lower than any other battery on the market! Their maintenance cost is practically negligible. They discharge at high rate longer and float at the same voltage all their life! Any way you figure—nothing beats

GOULD PLANTÉ

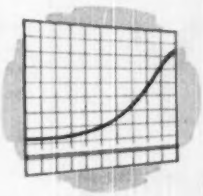
The Aristocrat of Stationary Batteries!

Gould Planté Batteries practically never need service and they need water only half as often.

Nothing Beats GOULD PLANTÉ!



Planté plates are pure, antimony-free lead—grooved to give highest amount of active material per square inch of plate surface.



Planté gives maximum economy because its cost per year remains the same while cost of ordinary battery increases.

GOULD

STORAGE BATTERY CORPORATION

Needless Contact Costs *Saved By Mallory Know-How!*

Important contact cost reductions usually result when Mallory is permitted to analyze applications and apply skilled attention to seemingly minor details.

In one particular case, a manufacturer of automotive voltage regulators requested that Mallory study his contact cost and performance. This study by Mallory disclosed that the amount of precious metal in the contact could be reduced considerably . . . without materially changing electrical characteristics. This reduction in silver content meant a saving to the customer of more than $3500 per year!

That's value beyond expectations!

Mallory contact know-how is at your disposal. What Mallory has done for others can be done for you!

In Canada, made and sold by Johnson Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario

MALLORY SILVER CONTACTS

Fine and coin silvers, while having desirable properties for many applications, do not provide the physical properties required for some applications. To cover these applications, Mallory has developed a series of silver base alloys. These alloys have such improved characteristics as greater resistance to wear, less sticking or metal transfer, and greater hardness. Mallory is fully qualified to recommend the best contact material for your design. Write today.

Electrical Contacts and Contact Assemblies

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Capacitors	Contacts
Controls	Resistors
Rectifiers	Vibrators
Special Switches	Power Supplies

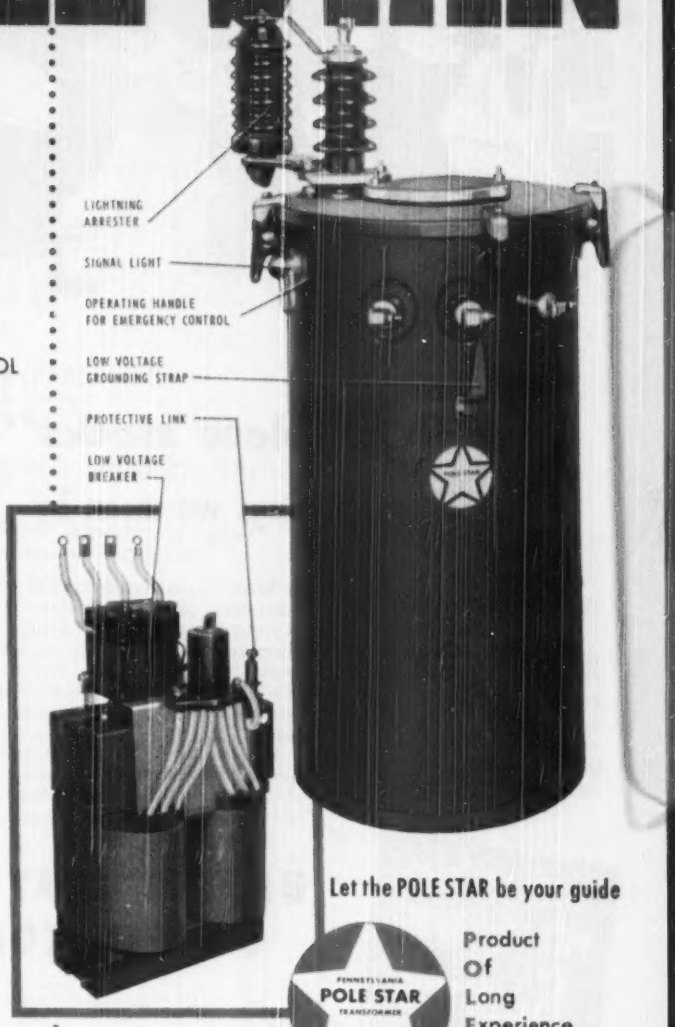
Resistance Welding Materials

THERE ARE MANY PROTECTED POLE TYPE TRANSFORMERS

but only ONE PROTECTED POLE STAR

All the Advantages of the POLE STAR, plus

- LIGHTNING ARRESTERS
- PROTECTIVE LINK
- LOW VOLTAGE BREAKER
- SIGNAL LIGHT AND BREAKER OPERATING HANDLE
- EMERGENCY BREAKER CONTROL
- GROUND DISCHARGE GAP or GROUND CONNECTOR



MANY distribution transformers are equipped with safety devices for maximum electrical protection. But only the Transformer manufactured by Pennsylvania gives you this protection PLUS the many decided advantages of Pole Star design and construction.

IN THE POLE STAR, Pennsylvania gives you a small, light, efficient transformer. The exclusive *Pennsylvania-Developed* and *Pennsylvania-Engineered* design gives you a transformer with an inherent low exciting current and a core that can easily be disassembled and rebuilt without appreciably affecting the original core loss or exciting current. And, the POLE STAR gives you added protection with its Sealed Tank construction and retained synthetic rubber gaskets.

Let the POLE STAR be your guide

PENNSYLVANIA POLE STAR TRANSFORMER

Product Of Long Experience

Safe Thrifty And Reliable

Pennsylvania **TRANSFORMER COMPANY**

CANONSBURG, PENNA. *Greater Pittsburgh District*

BARS - PLATES - STRUCTURALS - SHEETS - TUBING - REINFORCING BARS - STAINLESS ALLOY & HI-STRENGTH STEELS ALUMINUM - TOOLS - SUPPLIES MACHINERY
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"Complete stocks"... that's only one of the things we mean by Service Plus!

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TOOLS · EQUIPMENT
MACHINERY

● Many of our customers think of United States Steel Supply as the "department store" of the steel industry. That's exactly what we aim to be . . . a source of supply that always has a large diversified stock of steel, aluminum, tools, equipment and machinery on hand so that customers' orders can be filled promptly. Customers who shop around come to us with comments like these: "Only place we could find what we wanted." "We were hunting an odd size . . . *you had it!*" "U. S. Steel Supply was the only concern with all the stock we needed."

You can depend on us for more than complete stocks, however. *Service Plus* means quick delivery, and instant, courteous attention to any problems you have involving material selection. It means *You're the Boss* and we're going to do our best to keep you satisfied.

WHEN YOU DEAL WITH US, YOU GET Service Plus!

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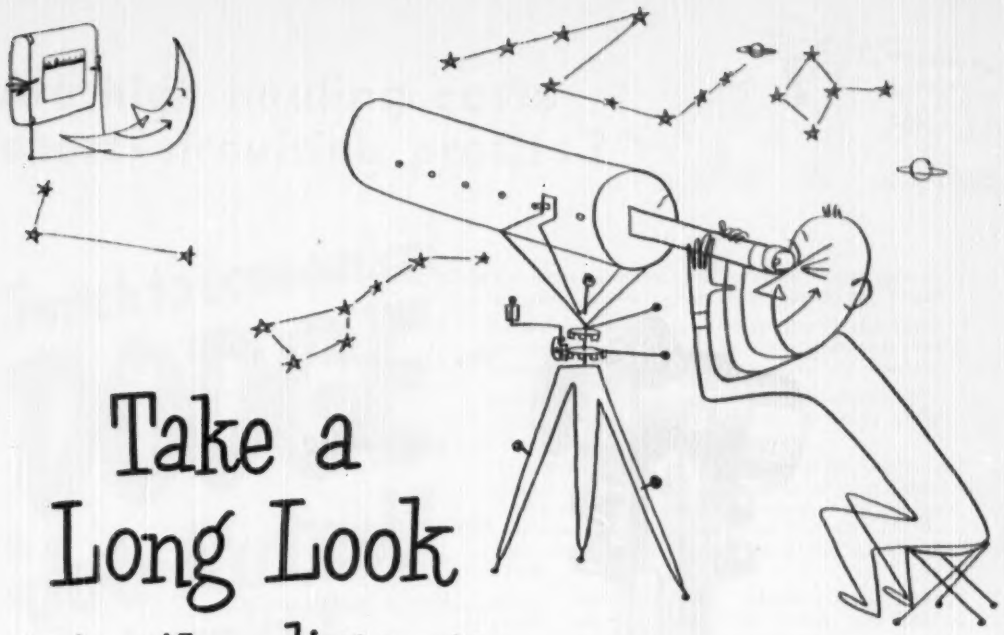
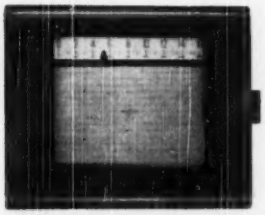
UNITED STATES STEEL



Take a Long Look into the distance

and see the facts you need for high efficiency

Bristol's Metameter System of Telemetering gives an accurate, up-to-the-minute account of conditions at remote points . . . enables you to anticipate abnormalities . . . prevent emergencies.



Bristol Strip-Chart Metameter Receiver

Used by load dispatchers of central station systems for readings of:

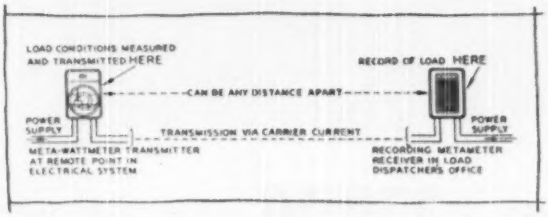
- load at each tie-line point
- output of each generating station
- totalized output (on a single instrument) of all generating stations
- active and reactive power and power demand at key points
- voltage and current at various points

And by operators of generating stations for readings of:

- output of each associated station —attended or unattended
- total output of generating station
- water level and waterwheel gate position
- water level—reservoirs, surge tanks, etc.

Readings can be transmitted any distance over any two-wire circuit or its equivalent—carrier-channel, telephone, telegraph or radio (including microwave) . . . to recording receivers (narrow or wide-strip chart or round chart) or indicating receivers with illuminated dials.

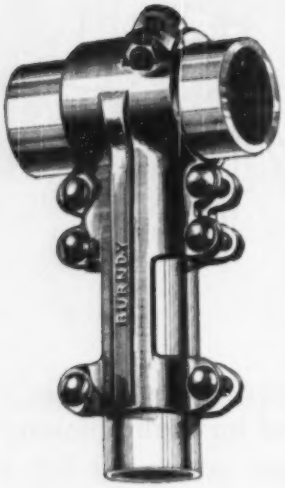
Write us for Bulletin M1700. THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 20, Conn.


LOAD CONDITIONS MEASURED AND TRANSMITTED HERE
RECORD OF LOAD HERE
CAN BE ANY DISTANCE APART
POWER SUPPLY
TRANSMISSION VIA CARRIER CURRENT
POWER SUPPLY
META-WATTMETER TRANSMITTER AT REMOTE POINT IN ELECTRICAL SYSTEM
RECORDING METAMETER RECEIVER IN LOAD DISPATCHERS OFFICE

BRISTOL

Gives You the FACTS When and Where You Want Them

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



with power connectors,

the character of

the **engineering**

determines the

quality of the product.

This relationship

is best expressed

in the

single

word...

BURNDY

Are high hauling costs short-circuiting profits?

Switch to economical DODGE "Job-Rated" trucks!

You can get a direct "line" to lower hauling costs by investing in an economical Dodge *"Job-Rated"* Truck!

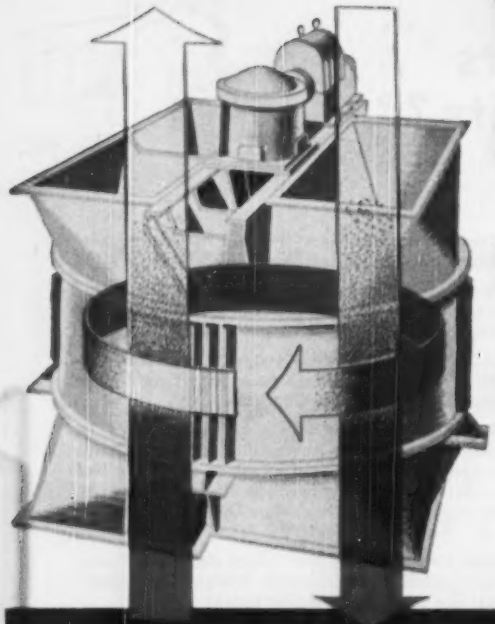
Such a truck will have an engine that's *"Job-Rated"* to give you power to spare. Along with this extra power, you'll get maximum gas and oil economy!

Every other chassis part will also be *"Job-Rated"*—engineered and sized to fit your job. Your Dodge Truck will cost you less to operate!

If your hauling is in heavy city traffic, you'll be pleased with the ease of handling of your Dodge *"Job-Rated"* Truck. If you go where roads are bad—or where there are no roads at all—you'll like the power and dependability of your Dodge *"Job-Rated"* Truck.

If high hauling costs are "short-circuiting" your profits, switch to economical Dodge *"Job-Rated"* trucks. See your Dodge dealer today!

With all their extra value **DODGE** *"Job-Rated"* **TRUCKS** are priced with the lowest



this preheater can save you money whatever your fuel

the *Ljungstrom* AIR PREHEATER

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

All fuels burn better with preheated combustion air, and it is a "must" for many of them, such as high moisture powdered coal. In addition, the *continuous regenerative counterflow* principle of Ljungstrom permits reliable operation at low exit gas temperature. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

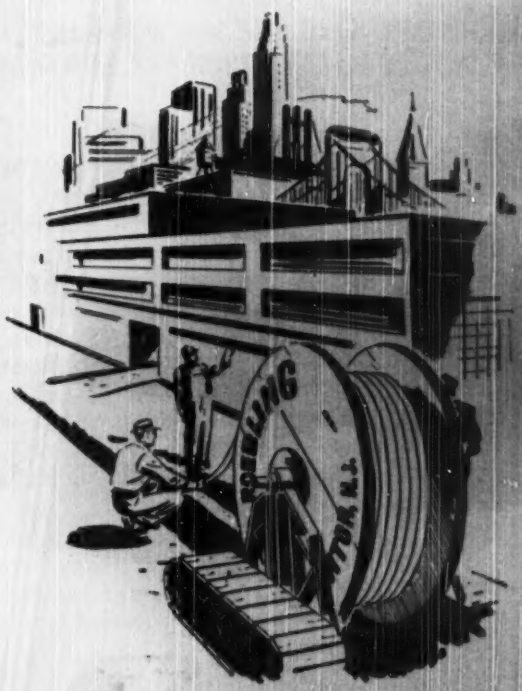
The efficiency and reliability of the Ljungstrom air preheater is a matter of record in industrial and utility plants throughout the country. That is why every year a constantly increasing percentage of the installed boiler capacity is equipped with Ljungstrom air preheaters.

If you are planning a new installation, or modernizing your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can raise the efficiency of your plant.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

Today it's Roebling!

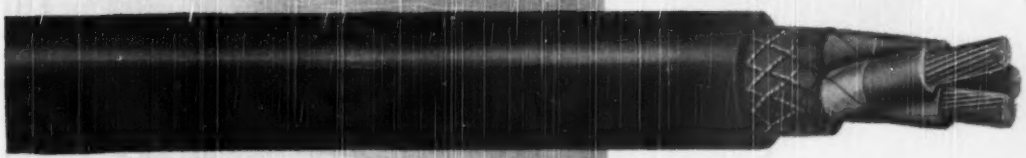


Why men who watch costs specify Roebling ROEPRENE Parkway Cable

THERE'S ONE BIG and deciding reason for choosing Roebling ROEPRENE Parkway Cable . . . it enables you to avoid the expense of underground duct systems! This cable is made for direct underground installation. Only a two- or three-foot trench is needed. And as soon as the cable is out of sight, you can put it out of mind. There'll be no service troubles from wind or weather . . . safe physical protection is assured by the non-metallic armor of a ROEPRENE sheath.

Roebling ROEPRENE Parkway Cable has rapidly become a top choice for series street lighting, parkway boulevard lighting, traffic signal, fire alarm, flood lighting, railroad yard, signal and many other circuits. It is available in single and multiple conductor types—solid or stranded—in a range from 600 to 5,000 volts.

Have your Roebling distributor or Roebling branch office help select the best cable for your special needs. John A. Roebling's Sons Company, Trenton 2, New Jersey.



From copper rod to finished cable all components of Roebling electrical wires and cables are manufactured in Roebling's own plants. Painstaking care, research, engineering and modern precision machines are your assurance of highest quality.

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● Now you can read the story of how The Standard Transformer Company has influenced the distribution of electrical power. You'll like the dynamic part this Company is playing in these advances. See the illustrated sections in this 20-page booklet devoted to STANDARD transformers operating in industry, utilities, rural electrification and many other interesting subjects, too. Also listed are 253 impressive installations of STANDARD transformers.

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For a complete description of the design and construction used in the manufacture of each type of transformer, write for the bulletins listed.

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THE STANDARD TRANSFORMER COMPANY
WARREN, OHIO

Please send me my copy of your new Installation Brochure titled, "Standard Transformers . . . on the job." Send it to:

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Unloaded... Installed... Operating... *in only 48 hours*

Recently a large steel corporation in Kansas City, Mo., ordered this nine-frame, 600 volt I-T-E secondary distribution switchboard as part of a modernization program to replace obsolete distribution equipment and provide additional interrupting capacity.

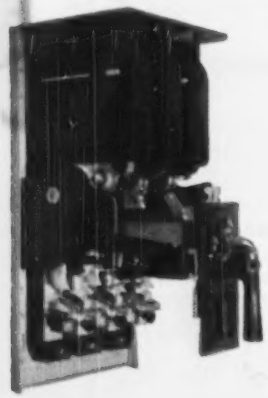
A quick changeover was essential . . .

Shortly after the switchboard arrived at a Kansas City freight yard, it was unloaded from the flat car and transferred by truck to the switchhouse, positioned relative to points of cable entry, main connections were made, and the power switch thrown—*all within 48 hours!*

This switchboard was installed easily, quickly and economically because it was *completely assembled* and *thoroughly tested* at the I-T-E factory prior to shipment. I-T-E engineered the job, supplied all components, installed all internal wiring, shipped the board as a complete unit. Only external cable connections were required after installation.

Here's proof that *you* can modernize *your* plant easily, quickly and economically. And there are many other benefits you get with I-T-E Low Voltage Switchgear. Here are a few:

- ***CAREFUL APPLICATION:*** I-T-E application engineers carefully apply the equipment to your needs and see that it is built to fit your requirements. All components that go into I-T-E switchboards are the finest obtainable, carefully coordinated into efficient functional units.
- ***ATTRACTIVE APPEARANCE:*** When you purchase other equipment you select it partly for appearance because you know how important it is to the efficiency of your personnel. Your plant personnel will react just as favorably to more attractive switchgear.
- ***DEPENDABLE CIRCUIT BREAKERS:*** No switchboard can be more dependable than the circuit breakers in it. I-T-E circuit breakers offer you the trouble-free protection so important to proper plant operation.



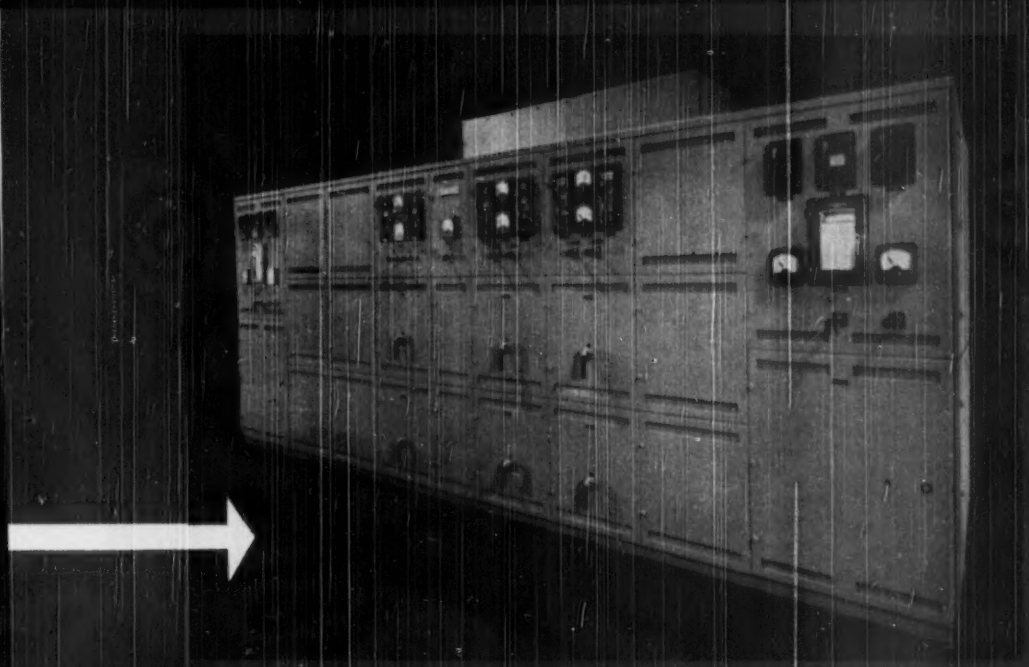
◀ *Positive-acting Air Circuit Breakers*
Type KB Breaker. 25,000 RMS Amp. Interrupting Rating. 600 Amp. Continuous Rating. 2, 3, or 4 Poles. Manually or Electrically operated.

Send for these descriptive bulletins: ▶

BULLETIN 6003-D: A complete reference guide to I-T-E 600 V. Switchgear Assemblies.

BULLETIN 7000-A: Describes I-T-E's newest 5 KV Switchgear.

Get both bulletins—ask your local I-T-E Representative, or write I-T-E General Offices.



MULTUMITE SWITCHGEAR IS COMPACT . . . EFFICIENT!

The compactness of I-T-E Multumite assemblies is well illustrated in the above photo. Behind the attractive exterior of this switchboard are strong, efficient breakers and components—designed and built to provide positive protection of secondary distribution systems.

Electrically welded steel frames—one for each vertical group of breakers—are bolted together on a continuous channel-iron sill (furnished by I-T-E) to make a strong, rigid, and self-supporting structure. In addition to keeping the switchboard rigid in transit, the sill provides an excellent vermin-proof base for installation.

For extra protection of equipment, each breaker is in a separate metal compartment formed by horizontal and vertical steel barriers welded to the frame, exterior metal panels, and the metal back of breaker itself.

This bus compartment is designed for easy access ▶

Here's another reason installation of I-T-E Low Voltage Switchgear is so easy. A spacious bus compartment with a single horizontal bus facilitates cable connections, makes them easy to get to, provides more space for outgoing cables. Full-height hinged doors swing wide, can be removed easily. The whole compartment is *planned* for maximum accessibility and greater convenience!

I-T-E

R&IE

For *more dependable* Switchgear

specify I-T-E!

I-T-E Circuit Breaker Company • 19th & Hamilton Streets • Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.

Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS • RESISTORS • SPECIAL PRODUCTS

GIVE YOUR HIGH VOLTAGE DISCONNECTS GREATER UTILITY

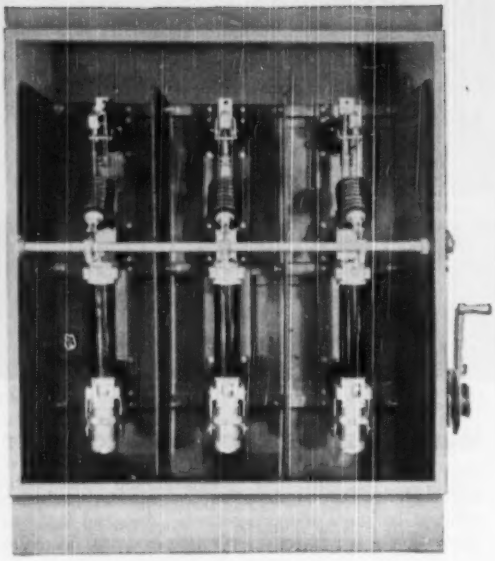
Your high voltage disconnects will have greater usefulness if they are of the "Three E" air interrupter type.

An ingenious interrupter unit with which this line of switches is equipped makes possible the efficient performance of many high voltage switching operations. The conventional disconnecting switch can be used only for the purpose of isolating apparatus.

Use of the air interrupter switches enables circuits to be opened while carrying full rated amperes at rated voltage. Magnetizing currents of transformers, also charging currents of cables, lines and busses can be broken successfully without system disturbances.

When combined with power fuses they provide inexpensive overload and short circuit protection.

● The indoor style as illustrated is standard factory production, open or metal enclosed, hook stick or group operated for voltage ratings to 15 kilovolts and ampere ratings to 600.

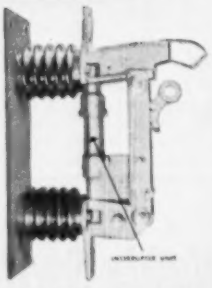


3 P.S.T. 600 amperes 15 Kv metal enclosed group operated switch with power fuses.

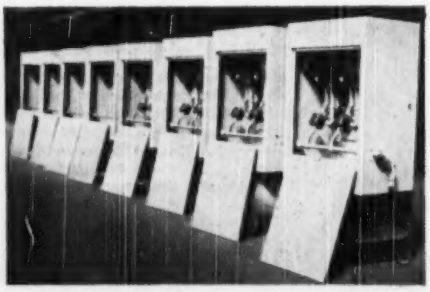
Ask for bulletin 141

● Before you purchase additional high voltage disconnects investigate the "Three E" air interrupter type.

The "Three E" interrupter unit is of the dry type using no oil or other inflammable liquids. Arc created by circuit interruption is confined and extinguished inside the arcing chamber of the unit. Interruption is fast (less than one cycle) and clean. There is no burning or pitting of contacts.



S.P.S.T. 400 amperes, 7.5 Kv open type hook stick Air Interrupter Switch.



Metal enclosed Air Interrupter Switches being assembled at factory.

THREE E

ELECTRICAL ENGINEERS EQUIPMENT CO.

MELROSE PARK, ILLINOIS

HUGHES BROTHERS developed and pioneered "X-Braced" construction, worked out the structural theory, and confirmed it by full-sized tests. The results: Thoroughly reliable transmission systems, and savings of millions of dollars for the electric utility industry.
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New circuits?

Unless you figure in aluminum, you don't

figure low

Figure insulated conductors both ways—aluminum and copper—and see how much you save with *aluminum*. You'll be surprised at the savings. And aluminum's lighter weight will speed the job.

For names of manufacturers and copy of "Questions and Answers about Insulated Aluminum Conductors", phone your nearby Alcoa sales office, or write ALUMINUM COMPANY OF AMERICA, 1786G Gulf Building, Pittsburgh 19, Pennsylvania.

Insulated **Aluminum Conductors**

ALCOA

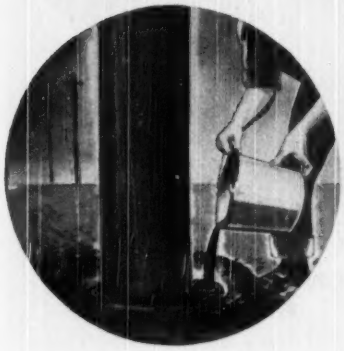
of ALCOA EC ALUMINUM are made by leading manufacturers

make relocated poles last longer with

MONSANTO PENTAchlorophenol

(SANTOPHEN 20)

BRUSH ON PENTA after pole has been removed and cleaned.



POUR ON PENTA after pole has been reset.

Here's how one utility uses penta to add years to the life of poles they set, pull and reset:

When a pole is removed and cleaned, a 5% solution of Monsanto Penta dissolved in proper oil is brushed on. The pole then is stored until it's needed in another spot.

In resetting the pole, the fill is tamped to within a few inches of the top. Two gallons of the penta solution then are poured around the wood. A bar is forced down along the pole to bring the preservative in closer contact with the butt end of the pole. The fill then is completed and a collar of sand or loose dirt is made at the ground line. A half gallon of penta solution is poured onto the collar and covered lightly.

Penta, applied in this way, is practical, effective, economical. Ordinary care in handling is necessary to protect workmen, animals, trees and crops.

If you would like more details about this use of Monsanto Penta, or if you want other information on wood preservation, mail the coupon or contact the nearest Monsanto Sales Office.

MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1758-E South Second Street, St. Louis 4, Missouri.

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CHEMICALS—PLASTICS

MONSANTO CHEMICAL COMPANY
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1758-E South Second Street, St. Louis 4, Missouri

Please send further details on the use of penta to preserve relocated poles. Send data on the use of penta for .....

Name ..... *Title* .....

Company .....

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City ..... *Zone* ..... *State* .....

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BETTER
than anything you have ever seen or tried before.

The answer to John Lineman's Prayer.

Perfectly aligned, tig assembled, zinc thimble—radio freed pin hole with Type "N" Glaze.
DATED! A permanent service record. And something new in contours—nimble and moisture shedding—radio freed glaze at all assembly joints.
1½" wire groove, ½" radius tie wire grooves—WOW!

A Complete Line to take care of Every Transmission Pintype Need.
(NEMA Standard)

The most radical departure from conventional insulator design in decades. Many designs were tried and tested. The final design is presented here. Utility Engineers, linemen and management will sing praises over the performance of these insulators for years to come. Write for folder describing the complete new line of Transmission Pintypes.

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Porcelain Products, Inc.

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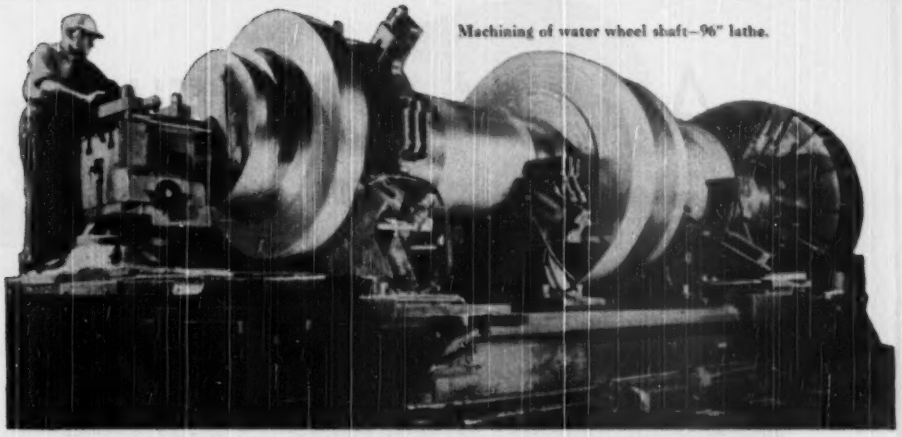
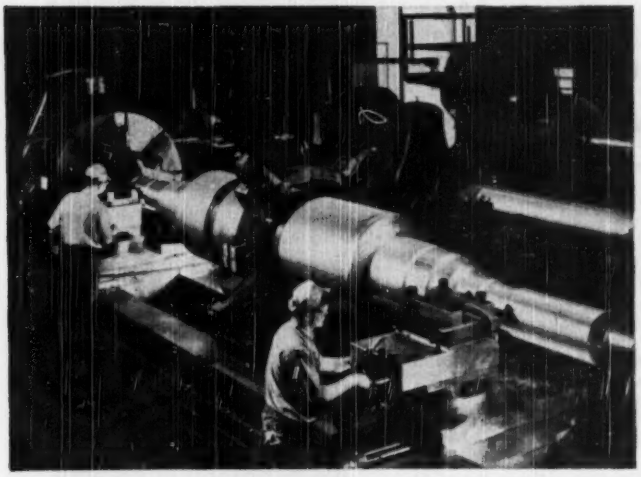


Machining of water wheel shaft—96" lathe.

heavy FORGINGS to your specifications



Turning generator shaft—60" lathe.

GENERATOR shafts . . . water wheel shafts . . . rotors . . . pinions . . . reduction gears . . . ship shafting, are only a few of the great variety of quality forgings regularly produced at the Homestead Works of Carnegie-Illinois Steel Corporation.

For these, and many other jobs, we make the steel, we forge it, and, if desired, will machine it to your specifications.

We cast ingots up to 110 inches in diameter. Our facilities include the most modern heat-treating furnaces . . . hydraulic presses of 2,000, 3,000, 7,000, and 12,000-ton capacities . . . and all the necessary turning, boring, and planing equipment.

As for personnel, the men in our shop not only have long experience, but are generally recognized as authorities in the forging field. This combination of men and equipment is your assurance that you will get the forging you want . . . *exactly as you want it.* We'd like to talk over your forging needs with you. There's no obligation, of course. Why not get in touch with us at once?

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH & CHICAGO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

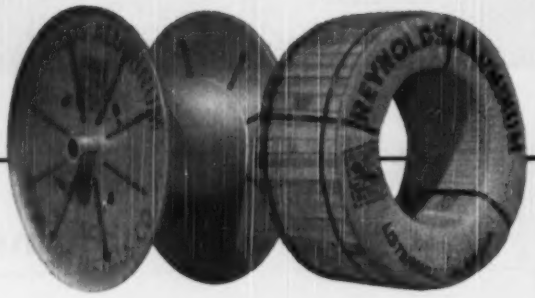
USS Commercial Forgings

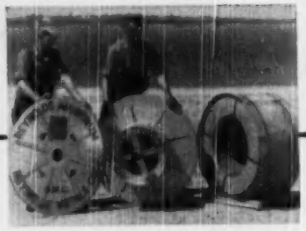
UNITED STATES STEEL

Announcing the NEW—

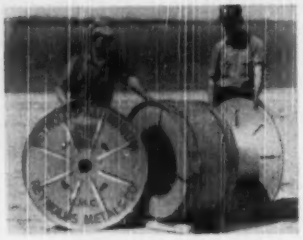
MASTER REEL AND COIL

OF REYNOLDS ACSR

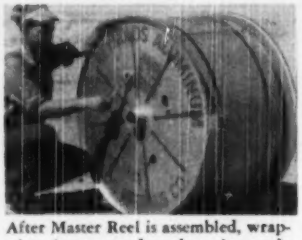




Lagging and waterproof wrapping are removed from Master Coil and head is removed from Master Reel.



Master Reel slips into Master Coil easily, snugly.



After Master Reel is assembled, wrapping is removed, and you're ready to go to work.

Eliminates wooden reels . . . and cuts down costs!

Wooden reels have always been a "headache" for cable users. And an extra expense, too. The handling, storing, record-keeping all add to construction cost.

With the new Reynolds Master Coil and Reynolds Master Reel, these expense-producing chores are cut right to the bone! The Reynolds Master Coil holds a full 40" reel length of cable —carefully waterproof-packed and lagged, protected against plenty of rough handling.

The Reynolds Master Reel is all metal, quickly taken apart and put back together around the Master Coil. It is far sturdier than a wooden reel, and can be used over and over again.

Equipped with a Master Reel or two, you can order Reynolds Master Coils as required. You save all the problems of conventional wooden reels. You save on needless weight handling —eliminate costly pick-up, storage, and shipping problems.

Find out how you can cut costs with this time-and-money-saving combination. For complete information, write to Reynolds Metals Company, Louisville 1, Kentucky.

ACSR MANUAL FOR ENGINEERS

Contains helpful information, complete charts and tables. Free when requested on business letterhead—write to Reynolds Metals Company, Louisville 1, Kentucky.

REYNOLDS METALS

REYNOLDS *Lifetime* ALUMINUM

CONSIDER ALUMINUM • CONSULT REYNOLDS • THE COMPLETE ALUMINUM SERVICE

After all is said...

it's still quality that counts plus proper designing, precision manufacturing . . . and PROOF OF PERFORMANCE. Since the beginning of the Electrical Industry, Thomas has been supplying porcelain for the most difficult insulation problems. Why gamble?

Despite these unusual times, when quality and skilled workmanship could be sacrificed, you can specify Thomas Insulators with full confidence that quality and value cannot be surpassed.

All Thomas Insulators have been constantly improved . . . quality workmanship is still the watchword of all production. Each insulator has the plus values to meet every type of line condition. Standard designs may be selected for your toughest assignments.

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AGENTS IN PRINCIPAL CITIES

You tell us...

THEN WE SHOW YOU

THAT'S the way Blaw-Knox builds Transmission Towers ... You give us exact specifications and we show you how skillfully our design-engineers interpret them and then transfer them from blueprint to steel. The structures resulting from such cooperation stand up indefinitely under whatever nature may hand out in the way of winds, ice, heat, cold and rain.

More than a generation of experience adds not one cent to the cost of a Blaw-Knox Tower —but it does assure the most for your tower investment.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
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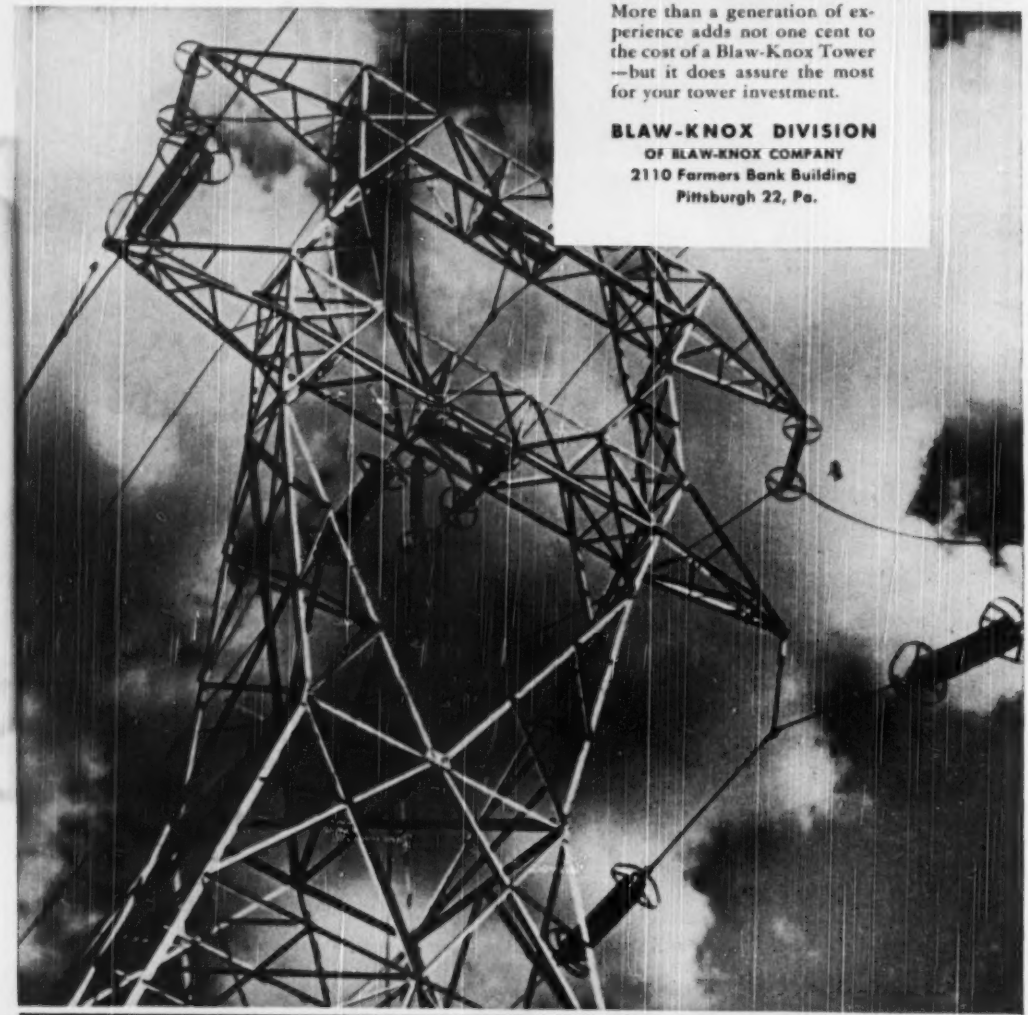


BLAW-KNOX TRANSMISSION TOWERS

NOW...

MOISTURE RESISTANCE

OZONE RESISTANCE

RESISTANCE TO HEAT and AGING

... All Three In One High-Voltage Cable!

Study the facts behind high-voltage cable failures and you'll readily realize just how much moisture resistance, ozone resistance, and resistance to heat and aging mean to high-voltage transmission and distribution systems. Now — for the first time — all three properties are combined in a single insulation, Anhydrex XX — available only in Simplex-ANHYDREX XX Cables.

Aged in an air oven at the grueling temperature of 250 F. (121 C.), Anhydrex XX has proved itself to be far and away your most dependable assurance of low-cost, trouble-free cable operation at the higher voltages. Here's how:

Aged for 16 weeks, it retained approximately 50% of its tensile strength, nearly 68% of its elongation. More than that, its rate of deterioration after the first few weeks was very slight, indicating exceptional stability and long life. It remained rubber-like in quality and appearance and was still suitable for further use. Compare this with ordinary vegetable oil base and heat-resistant compounds which, inside of only 3 weeks, became brittle and cracked and crumbled.

Aged for 7 days, Anhydrex XX was immersed for a week in distilled water at 158 F. (70 C.) and absorbed less than 15 mg. per square inch of exposed surface.

Aged for 7 days, it was bent around a mandrel and exposed to .03% ozone for 4 hours yet would not crack.

Compare these values with those of any other high-voltage insulation. You'll find a big difference; a difference that pays off in more economical, more efficient, and more reliable power transmission whenever Simplex-ANHYDREX XX Cables are on the job. If you would like more complete information and specification data on Anhydrex XX, simply drop us a line at the below address.

SIMPLEX WIRE AND CABLE COMPANY
79 Sidney Street, Cambridge 39, Massachusetts

Sangamo J Watthour Meters

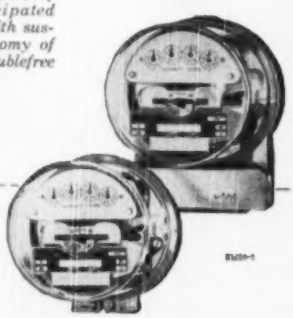
Sangamo J Meters have a good reputation for long troublefree service. They are designed to reduce repairs to a minimum . . . They have unusual freedom from electrical failure due to high insulation levels . . . Troublefree operation is inherent in the oilless bearing system.

But when infrequent repairs *are* needed —all that is necessary is a small stock of interchangeable parts, and a minimum of time. Even a potential coil or a current element can be easily replaced in a matter of minutes—right in your own shop—with Sangamo's separable electromagnetic element! You can replace any part of a Sangamo J Meter and be well within the range of adjustment.

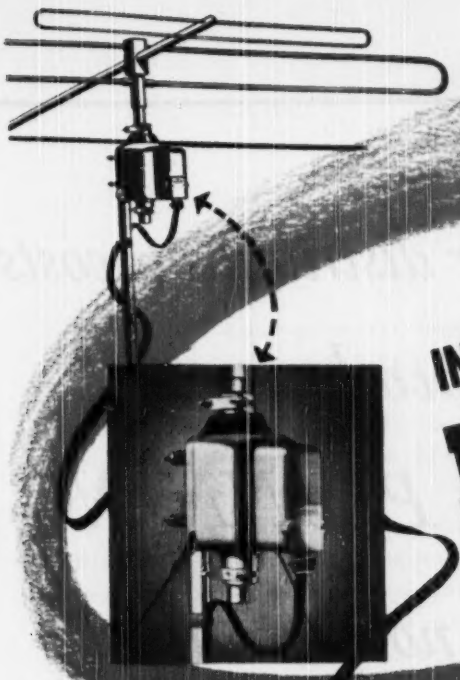
Sangamo Watthour Meters on your system mean lower labor costs, a smaller stock of parts, and fewer meters on the shelf.

* * *

Sangamo J Meters have proved their ability to meet the requirements of today and the anticipated loads of the future with sustained accuracy, economy of maintenance and troublefree performance.



SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

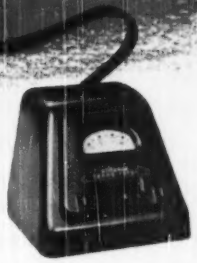


alliance
TENNA-ROTOR

INSULATED WITH NATVAR 400

AIMS THE ANTENNA IN ALL KINDS OF WEATHER

The ALLIANCE TENNA-ROTOR rotates the antenna ... wise or counter-clockwise ... with a positive mechanical stop at end of travel. In the Model DIR (illustrated), sensor in rotator unit operates meter in control box to show direction. Reversible motor in rotator unit operates on 24 volts supplied by transformer in control box through a 3-position switch. Motor leads are insulated and protected by Natvar 400 extruded vinyl tubing.



The TENNA-ROTOR, made by Alliance Manufacturing Company, Alliance, Ohio turns a beam antenna to the compass point where interference is least and reception is best.

It is designed and built to operate for years exposed to rain, snow and sleet. For this rugged service, components are carefully tested and selected. Natvar 400 extruded vinyl tubing is used in the rotator unit for motor leads because of its superior resistance to weather.

Natvar 400 also has uniformly superior resistance to oil, and is approved for continuous operating temperatures of 105°C. Prompt deliveries can be made either from a nearby wholesaler's stock or from our own. Full Underwriters report on request.

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- Varnished cambric—straight cut and bias
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- Slot insulation
- Varnished tubings and sleevings
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Lower distribution costs

depend on

PLANNING

not patching!

YOU CAN BE **SURE**.. IF IT'S
Westinghouse

PATCHING is a temporary and often costly expedient . . . particularly in the case of a distribution system. Today's load forecasts strongly suggest that only long-range system *planning* will enable you to serve future loads economically.

It is important to decide *now* on the objectives to be attained . . . and work toward these objectives as you expand or make replacements to your present system. Current trends offer helpful direction . . . and they indicate that the pattern of the future will be . . .

A simplified system! One in which complex interconnections and costly problems of relaying are eliminated . . . one requiring a minimum of equipment . . . less maintenance. On the subtransmission level, *simple loop or radial patterns* seem to best fit this description.

There are opportunities to combine simplicity with quality service and operating economy in other parts of the system, too. The increased use of spot networks, secondary networks and banked secondaries attests to this. It also indicates wider use of a second cost-cutting tool . . .

Standardized, factory-assembled substations! The inherent flexibility of these units permits you to economically employ any of the systems mentioned. Less-costly bus regulation, minimum use of high-voltage buses, and shorter distribution feeders are several important reasons.

Let these facts set the course for your system planning . . . and let Westinghouse help. Our engineers and complete system planning facilities are at your service. Call your nearest Westinghouse Office or write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-97148

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"Electric Utility Power Distribution Systems", B-3905
"Co-ordinated Substations", B-4061
"The A-C Secondary Network System", B-4002-A

Westinghouse
SYSTEM PLANNING SERVICE

At 66 this KERITE is still live

FROM 1883 until 1917, when it was replaced by a cable with more conductors, the Kerite non-leaded submarine cable shown above operated without a single service interruption. It was installed on a 360-volt telegraph circuit under North River, New York City, and terminated near a sewer inlet.

Although the corrosive action of the polluted water destroyed the steel wire armor, the Kerite insulation was unharmed. Made in 1881, this piece of cable has spent 34 years under water, and 32 years in air. The physical and electrical characteristics of the Kerite insulation are still excellent.

Modern Kerite cable is still insulated with Kerite made by the same time-tested formula. And modern Kerite engineering has brought many advances to the art of cable making. Kerite engineers will be glad to consult with you on your cable problems. *The Kerite Company, 30 Church Street, New York 7, N. Y.*

Offices also at: 122 S. Michigan Avenue, Chicago 3; 582 Market Street, San Francisco 4; 714 W. Olympic Blvd., Los Angeles 15.

Kerite Insulation—Your Cable's Best Life Insurance

KERITE CABLE

A Board for Impartial Analysis

A STATEMENT covering recommendations for a national water policy has been submitted to the President's Water Resources Policy Commission by the Water Policy Panel of Engineers Joint Council. The council is an organization of the five major engineering societies. As compared with the policies proposed in other statements submitted by EEI, NAEC, the Hoover Commission, and other interested parties, it does not differ widely. Perhaps its most significant contribution is its completeness and the non-partisan connections of the committee members. It is also worthy of note that their criteria for considering national water policy were based on two axioms—"that public money is limited in availability and that many public needs, such as water, highways, schools, hospitals etc., compete for public money."

Among the many practical proposals, a most significant one has to do with the screening of projects which are to be provided by the federal government. The panel proposes a board for the impartial analysis and appraisal of federal water projects. They recommend that the board's review and report be prerequisite to authorization or appropriation by Congress for such facilities.

In justifying this review board the council makes the observation that "agencies which are under the necessity of competitive survival, with high principles but with equally high desires to develop in size and significance, cannot be expected to appraise the validity of undertakings in the most abstract and impartial manner." It follows that the body would have to be drawn largely from outside governmental personnel. But in giving due credit to other factors the council feels that the board should include some individuals of non-engineering experience, to provide economic, financial, regional and sociological perspectives.

ELECTRICAL WORLD believes that the proposal for a board for impartial review is very sound. Regardless of the outcome of efforts to consolidate federal activities relating to water resources, the basic danger exists that uneconomic and unnecessary projects will continue to be approved.

Claims for benefits which cannot be substantiated would no longer be the rule as is true of current programs. As a typical example all of the states surrounding the TVA area, except Kentucky, have gained more in income per capita since 1929 than the State of Tennessee. Without trying to discredit TVA as an operating electric system, it is clear that the claims for economic benefits from subsidized power cannot be proven when the facts are available.

Other highly desirable recommendations made by the Water Policy Panel of the Engineers Joint Council are covered elsewhere in this issue of ELECTRICAL WORLD. We believe this report to be a fine contribution to the Water Resources Policy Commission. Its proposals should be given serious consideration in every respect and the elements incorporated in the commission's report to the President.

Cooperation That Does Not Cooperate

NO MATTER how hard you try to make people love you, there will always be some to find fault. The electric utilities should take as much comfort as they can from that observation on human nature. But we wonder, in respect to their relations with the local electrical trade, just how much comfort they are entitled to take from it.

One of our editors attended the summer convention of the National Association of Electrical Distributors in Atlantic City last month. Somewhat out of his element, being a power company man by sympathy, experience, and association, he was not well acquainted among the wholesalers. But he had to justify his expense account by mixing around a bit and digging up something to make copy for the magazine. This is it.

At random he approached a number of wholesalers, whom he did not know and who did not know him, and asked each one for an expression as to the attitude of the local trade toward the utility. Of eight men thus questioned, two replied that the utility was well regarded by the dealers. The remaining six gave answers that indicated a range of feeling from mild disgruntlement to outright animosity. One said the power company talks a lot about cooperation but does not work at it very hard.

This was not an organized survey in any sense. Probably such a survey would reveal a much higher proportion of friendliness of dealers toward utilities. We hope so. But so long as dealers in any locality are not working in full amity with the power company, just so long will development of the potentialities of electric service in that area be hampered to an important degree. And since the utility is inevitably the local leader of the industry, it must accept responsibility for any animosity of dealers toward it. A little soul searching seems to be in order for more than a few power companies.

Telemetering

TELEMETERING has spread in two distinct directions that have not had too much in common except the name. In utility and industrial circles the art of remote indications has not only been well established but has had relaying, communication, supervisory control added on the same channels. It has become an indispensable aid to system operation and process supervision.

Within the last few years telemetering of a different complexion has acquired an equally indispensable status in the technology of guided missiles. To differentiate it from the conventional variety this has been called mobile telemetering. Either or both sender and receiver are customarily in motion in contrast with point-to-point telemetering in which case both sender and receiver are fixed.

Mobile telemetering resorts to microwaves and pulsing. Except for the receiving indicators and recorders the apparatus bears little resemblance to the earlier terminal equipment used with power-line carrier telemetering.

Power companies are cost conscious about telemetering facilities but seem to care comparatively little about weight and space factors. Those who are developing guided missiles are apparently little concerned about cost, but they invariably insist on light-as-a-feather weights. They also want ability to send and receive 20 or more items of information about acceleration, velocity, altitude, barometer, temperature, humidity, trajectory, etc. Further, these items have to be repeated accurately many times in the short flight life of the missile.

For wire-system telemeter engineers, herein lies the opportunity to adopt some of the clever techniques of mobile telemetering. This can be done as fast as the expansion in the power field indicates the need for more items of information, more flexibility, less weight, or enlarged scope. That was the lesson derivable from the 3-day joint conference in Philadelphia of the AIEE and the National Telemetering Conference.

For Better Public Relations

IN THESE DAYS when public relations are so important to the electric utility industry, it would be wise for each utility president to make a study of his own public relations department. In many companies public relations and advertising are still firmly entwined. A recent study by C. Fred Westin, Public Service Electric & Gas Co, Newark, for the Public Utilities Advertising Association (EW, June 26, p 4), has brought out the fact that men heading such departments are often involved in as many as 20 or more different and sometimes unrelated activities.

No one man is capable of close supervision over so many assignments. It might be wise for each utility to analyze activities being carried on in the advertising and public relations fields. Even with this information it will be hard to evaluate the work being done. Who can estimate the value of the hour spent by the public relations director in conversation with the mayor of a city, editor of the local paper, the president of the Women's Club, the town's leading clergyman, or school superintendent?

The solution may be to separate advertising and public relations functions and to provide an adequate staff for each. Such staffs properly manned and directed mean better community relations, and in the long run, bigger profits.

Harry I. Harriman, New England Pioneer

ANOTHER progressive pioneer of the electrical industry is dead. Harry I. Harriman was a progressive pioneer in every sense of the word. He and his partner, Malcolm Chace, had the foresight to see New England's need for industrial electric energy. They saw that this could be supplied by building hydro plants miles away from industrial centers and that this power could be transmitted there. Harriman needs no memorial. The New England Electric System will suffice.

The Electrical Week

Despite agitation for federal power projects, New England utility companies are keeping ahead of the area's power needs with a $500-million expansion program. Reserve capacity of their plants already exceeds total estimated U. S. output of the proposed St. Lawrence power project (p 74) . . . On advice that Interior Department and Southwest utilities soon would contract for distribution of federal power, a Senate committee slashed Southwestern Power Administration's 1951 budget by a third. But Interior refused to confirm reports of imminent agreement with the companies (p 76) . . . Houston Lighting & Power Co speeds construction and maintenance of its rapidly growing system with area service centers especialy engineered for efficient handling of equipment (p 78) . . . Engineers Joint Council, representing the five national engineering societies, calls for a fresh approach to federal water policy (p 79) . . . And Washington reports indicate there's little chance utilities will be affected by the draft in the early future (p 77).

• • •

Surprise appointment of Gordon E. Dean to head the Atomic Energy Commission apparently pleased both friends and critics of AEC in Washington. The appointment, which does not require Senate approval, followed confirmation of Sumner Pike to a four-year term by a vote of 55-24. Opposition to Pike, who had been acting chairman since Feb 15, was aimed in part, at least, to keep him out of the chairmanship.

Oklahoma politics have become entangled with negotiations of Interior Department-power company contracts in the Southwest. Senator Elmer Thomas, who is seeking reelection, long has urged such agreements. His Democratic primary foe, Rep Mike Monroney, a public power enthusiast, is opposed.

Since 1940, says Pacific Power & Light Co, Portland, not one new public utility district has been organized in either Oregon or Washington. A dozen such proposals have been defeated by the voters. About 66% of all customers in these states are still served by investor-owned companies.

Federal Reserve Bank of Boston has published a 13-page survey of New England industrial power costs based on 1947 data. Manufacturers then paid 1.45¢ per kwhr against 0.9¢ for all U. S. industries. Average cost of all fuel per million Btu was 33.1¢ in New England compared with 22.5¢ for plants elsewhere in the U. S. Despite this, the ratio of power costs to value added by manufacture was but 1.86% for New England and 1.7% for the entire country.

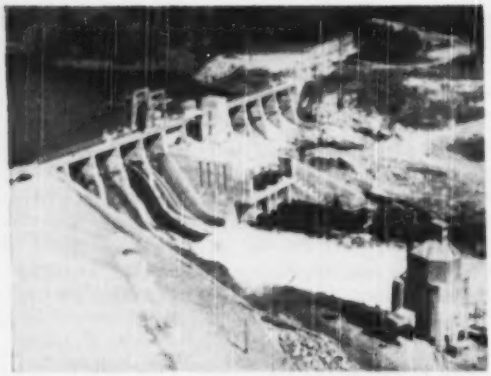
May was a quiet month in the industry so far as adding new capacity was concerned. Only 324,490 kw went on the line.

Gulf Public Service Co, Dallas, Texas, reports that in 1947 it bottled and sold 277,158 cases of Coca-Cola and other products. It also sold some electricity (103,322,507 kwhr), gas, water, and ice.

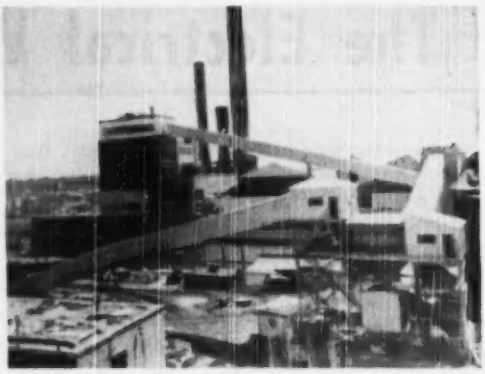
Steel for the new addition to the Oswego Plant of the Niagara Mohawk Power Corp was erected by 40 full-blooded Iroquois Indians.

Notes From The News

Niagara Mohawk Power Corp has been granted a 50-year license by the Federal Power Commission for construction and operation of a $5.6 million power plant on the Sacandaga River in Saratoga County, N. Y. The plant will include an earth dam 1,650 ft long and 112 ft high . . . The president of the Salt River Valley Water Users Association is in Washington to try to sell the government two diesel power generators owned by the Water Users . . . After failure of equipment at its Caddo Lake steam plant in northwest Louisiana, Southwestern Gas & Electric Co negotiated a short-term contract with Southwestern Power Administration for power from Narrows Dam. The utility will purchase SPA power for a period of 60 days. Southwestern G&E has been trying to get a long term contract from SPA . . . Five Puget Sound Power & Light Co employees have formed a "Reddy Kilowatt Patrol." The men, Boy Scout committeemen and scoutmasters, were reporting for leadership training and adopted the name when they discovered all in the same scout patrol . . . New Brunswick Electric Power Commission has started to set up a province-wide radio network aimed at faster location and repair of trouble on transmission lines . . . President David W. Jardine of Pennsylvania Electric Co turned over the first shovelful of dirt July 6 for an addition to the Front St generating station . . . The erection of 250 new street light poles has been approved by the Rantoul, Ill., board of trustees. The new lights will improve lighing in residential sections of village.



SKELTON STATION of Central Maine Power Co on the Saco River has a capacity of 16,800 kw. Many hydro plants are small



WEBSTER STREET PLANT of Worcester County Electric Co of Worcester, Mass., added 33,000 kw, boosting capacity to 83,740 kw

New England Builds Up Power Reserve

Margins After All Anticipated Requirements Estimated in Excess of 19% Through 1953, More Than Firm U. S. Capacity of St. Lawrence Development

THERE'S A LOT OF ARGUMENT about the amount of hydroelectric power that remains undeveloped in New England's rivers and tidal waters. But from the single viewpoint of area power requirements, it appears to be an academic row. Electric utility companies, now enjoying reserves of about 19%, are in the midst of a plant expansion program that will give the area an even greater margin of reserve power capacity over all foreseen requirements in the next three years.

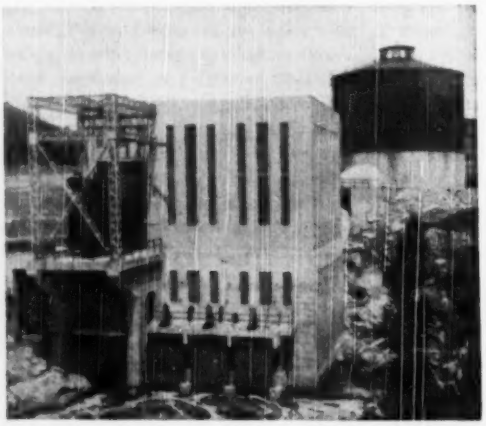
New England companies are building and expanding both hydro and fuel generating plants. Of the total 1.8 million kw being added in 26 major generating stations — new or expanded — about 100,000 kw will be hydro capacity. The companies' postwar (1946-52) expansion program calls for expenditure of more than $500 millions, three-fifths of it for generating facilities.

Retirement of obsolete plant is an important feature of the program. To overcome the handicap of New England's high fuel costs, the companies are anxious to dispose of inefficient equipment. In addition to new hydro capacity and modern high-efficiency steam units, they are installing gas turbine and mercury units.

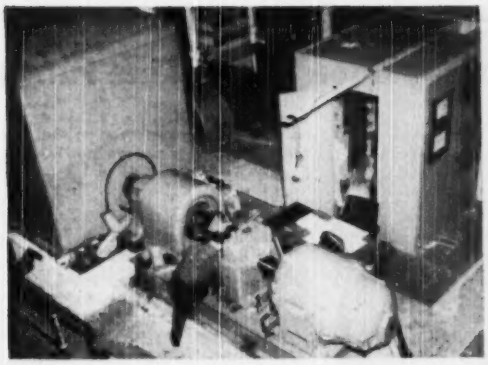
According to latest available reports, total capability of New England generating plants—exclusive of Maine—will approximate 3,491,000 kw this year. Annual peak loads for the same systems are expected to hit 2,823,000 kw,

(Continued on p 76)

FLOATING POWER PLANT "Resistance" (A) adds 30,000 to 40,000 kw of Schiller Plant (B) of Public Service Co of New Hampshire

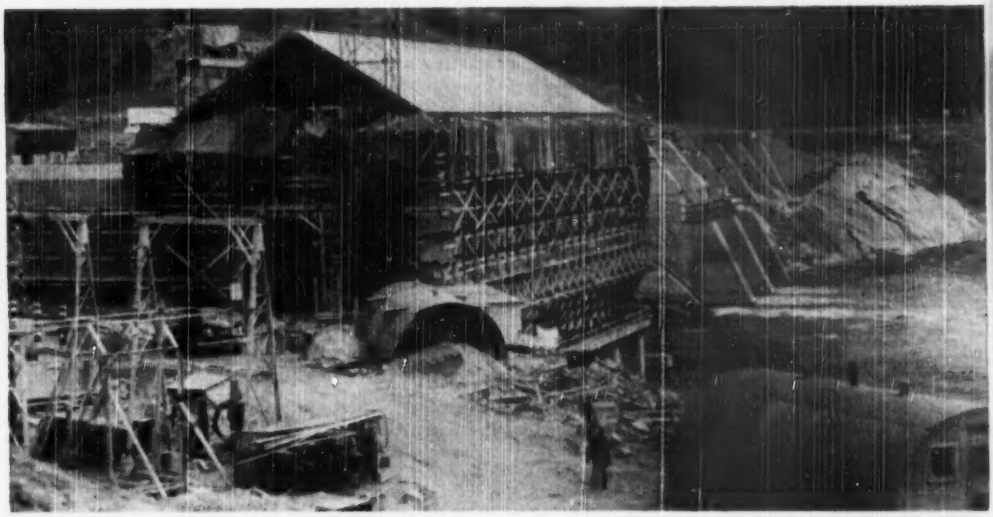


ANOTHER installation of the Public Service Co of New Hampshire is new 15,000-kw J. Brodie Smith Station on Androscoggin River

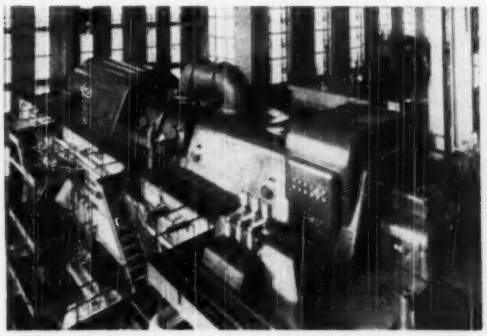


NEW ENGLAND utilities are progressive. This 4,000-kw gas turbine at Central Maine's Farmingdale Plant is latest in equipment

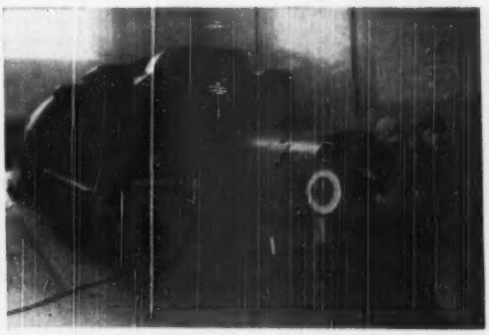
DEVON PLANT of Connecticut Light & Power Co at Milford has been expanded since the war. New installations added 157,000 kw



WILDER PLANT of New England Power Co on the Connecticut River at Hartford, Vt., has been redeveloped to increase its capacity from 5,220 kw to 33,000 kw. New England utilities deny they neglect hydro, pointing out many redevelopment projects are under way



LARGEST UNIT in New England is a 81,250-kw steam turbo-generator at 239,110-kw Edgar Station of Boston Edison Co



HARTFORD ELECTRIC LIGHT CO's newest unit at South Meadow Plant, Hartford, is a 45,000-kw job. Plant capacity is 180,000 kw

leaving a reserve margin of 668,000 kw. As pointed out recently by Clarence W. Mayott, official of the Hartford Electric Light Co and vice chairman of the Edison Electric Institute's power survey committee, this reserve exceeds the estimated firm capacity of U. S. power facilities of the proposed St. Lawrence development. The St. Lawrence plants would have a firm output of about 570,000 kw for U. S. consumption.

Mayott's calculations fixed New England's total reserves after meeting all demands in 1953 at approximately 765,000 kw. These figures again exclude Maine, which has a State law forbidding power exports. Many experts, including some in federal agencies, doubt that any significant amount of the proposed St. Lawrence power would be available to New England. It seems clear that, no matter what the amount, it could only replace power from existing plants in the area.

•

Transmission Lines Okayed

Arkansas Power & Light Co has been granted permission by the Arkansas Public Service Commission to build two large transmission lines. One line, costing $415,000, will run from Gold Creek in Faulkner County to Heber Springs. The second from Jones Mill near Hot Springs will cost about $520,000. AP&L also was granted formal approval for construction of a $15,000,000 steam generating plant near Forrest City now under way.

New Atom Boss

GORDON E. DEAN, former West Coast attorney, professor, and Justice Department aide, has been made Atomic Energy Commission chairman

Senate Committee Slashes SPA, Reclamation Power Line Funds

THE SENATE APPROPRIATIONS COMMITTEE has cut two major federal power programs where it hurts—in their appropriations for fiscal 1951. The cuts may not stick, even in the Senate itself where the matters soon are to be voted upon. But they are almost certain to result in some revision of federal power plans.

The slashes came when the committee acted on the $34.6-billion omnibus appropriations bill providing funds for all federal agencies.

SPA Cut $6 Million

The most significant cut of power funds was a $6 million slash in the budget of Interior Department's Southwestern Power Administration. The reduction represented more than a third of the funds previously approved for SPA by the House. In setting the agency's expenditures at a total of $11,010,400, the committee eliminated more than 75 proposed SPA transmission lines and substations in Oklahoma, Arkansas, Missouri and Kansas.

The committee announced it had based this action on "assurances" that SPA and power companies of the area had reached an agreement that would make federal construction of the facilities unnecessary. Interior Department sources refused to confirm the existence of such an agreement. They admitted only that Interior had received a new proposal for company transmission of federal power in the Southwest.

The Bureau of Reclamation, another Interior agency, also lost some of its pet power projects by the committee action. But the committee gave the Bureau funds for other projects denied by the House.

2 Montana Lines Out

Reclamation would lose two Montana transmission lines—one under construction—in the Senate committee's bill. Both lines were opposed by Montana Power Co. The committee called for a halt in construction of the controversial Havre-Shelby line, authorized last year. The House approved $1.4 million for continuing work on the line.

The committee action was based on Montana Power Co's new 5.5-mill rate to rural co-ops. The new rate, which was approved by the Montana Public Service Commission April 12, equals the Reclamation Bureau's charge to co-ops. The committee said the rate eliminated any savings that might have resulted from construction of the line, which it noted "was only recently begun."

Also knocked out was the House-approved Canyon Ferry-Great Falls line for which the Bureau sought $365,000.

"The committee expects the Reclamation Bureau and the Montana Power Co to negotiate, giving appropriate weight to the distances involved, a wheeling agreement for the disposal of Canyon Ferry power," the committee's report stated. Interior insistence on a one-mill-per-kwhr wheeling fee has stalled negotiations with the company.

Dakota Lines Added

But Reclamation was handed $6 million for more than 700 miles of transmission lines in South Dakota. And the Senate committee's bill would restore two major items cut out by the House: $750,000 for Folsom power plant in California's Central valley, and $504,000 for the Brighton-Hoyt-Brush transmission line in Colorado.

Biggest boost for federal power was partial restoration of the 25% cut the House handed the Army's Corps of Engineers. The Senate committee restored two-thirds of the House reduction, giving the Corps a total of $731,546,000 for its flood control, and rivers and harbors programs.

Phone Funds Upped

Rural Electrification Administration's load fund would be continued at $350 million per annum, plus an additional $150 million if needed. The Senate committee also upped farm phone loan funds from the House figure of $25 million to $40 million.

REA also was warned: "The committee is somewhat concerned by the large increases in . . . loans for generating and transmission facilities." The committee added it believed "no load should be made for construction of such facilities unless in areas where private power companies cannot or will not furnish adequate power at reasonable rates and within a reasonable time."

Interior's Southeastern Power Administration received $100,000, compared with a budget estimate of $175,000 and a House grant of $150,000. Bonneville Power Administration funds were cut to $39.5 million in cash and $20 million in contract authority for construction, and $4.5 million for operation and maintenance.

Utilities Won't Feel First Draft Call

Editor's Note: Cries of "Here we go again!" greeted news from Washington that the Selective Service System was being revived. That attitude appears premature, to put it mildly. As this issue of ELECTRICAL WORLD went to press, the only actual use being made of the draft was its response to an Army call for 20,000 men. Manpower of the utilities should not even feel a draft of such proportions. True, there may be more calls if the crisis worsens. The following article was prepared to give utility management and employees the best available information on how the draft may affect them under presently foreseeable circumstances.

Utilities may get occupational deferments for certain employees under the 1948 draft law. Decisions in individual cases will be left up to local draft boards. Employers seeking exemptions should write their local boards, giving their reasons, if they think any employee between 19 and 26 should be deferred.

Industry Gets 2-A's

There are two classifications for job deferments, 2-A for men necessary in industrial occupations, and 2-C for essential agricultural workers. As of May 31, 40,900 men were classified as 2-A, 133,800 as 2-C.

Under the present law, draft deferments may be given to any person whose job is found necessary to maintain national health, safety or interest. Also deferable are men whose continued activity in study and research is necessary in the national interest. This language is very broad, leaving it up to employers to convince draft boards of the status of individual workers.

No Group Deferments

There are no group deferments by job classifications. Nor have any standards been fixed for determining the essentiality of workers.

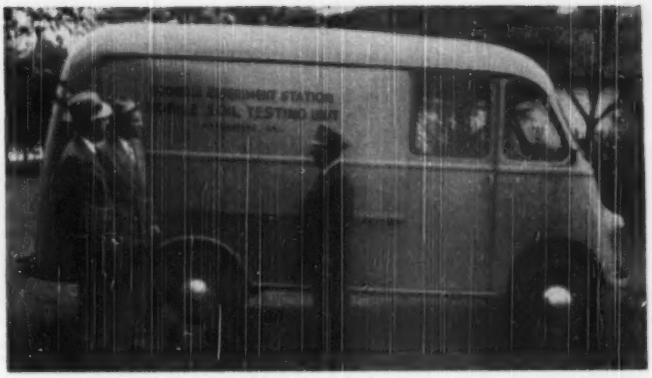
This probably means that utilities will enjoy the same latitude they had during World War II in setting essentiality. Then they were able to get deferments for most trained employees outside sales and clerical departments.

So long as the draft is limited to men from 19 to 26 it is likely to have little impact on the utilities. Particularly since men in this age bracket with prior military service will not be called. Men with dependents and reservists also are deferred.

Just how much use is to be made of the draft is impossible to estimate, even if the uncertainty of the Korean crisis were discounted. The armed forces now are about 550,000 men short of their legal manpower limit of 2 million. But no Washington sources expect the services to attempt to attain full legal strength within the near future.

The status of reservists also is unclear. The services are relying on calls for volunteers among their reserves. And a compulsory call—if any—will be preceded by the draft.

Even then reservists may be deferred, depending upon individual circumstances. Value of a reservist to the armed forces will be weighed against his essentiality in civilian life.



SOIL TESTING mobile unit is presented to the Georgia Experiment Station by Georgia Power Co as part of the utility's program to promote farm electrification and better farming methods. Accepting the unit is Dr C. C. Murray, right, director of the experiment station. With him are L. W. Gray, manager of rural division, and Bud Moss, agriculture agent, of Georgia Power. The unit can handle 100 tests in eight hours

•

Dam Authority Petitions Court for Indian Lands

Grand River Dam Authority, Oklahoma, has started proceedings in federal court to obtain rights-of-way for power lines to serve Stilwell.

The Authority's general counsel, filed a petition covering 15 tracts of Cherokee land, and asked the court to appoint a commission to appraise them. He said the Authority already has obtained rights of entry on most Indian land through which the lines will extend from Tahlequah to Stilwell, a distance of 23 miles.

Tahlequah is now served by the Authority and work has started on the transmission lines there and also on a sub-station which will be completed this month.

•

Gets 30-Year Franchise

Voters in Bradenton, Fla., have granted Florida Power & Light Co a 30-year franchise to operate in the city.

American Stockholders Challenge Loan to WWP

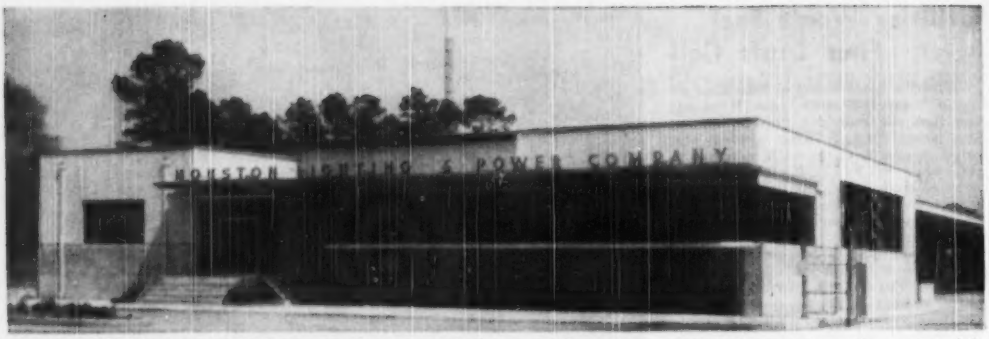
Hearings before the Securities and Exchange Commission have been requested on American Power & Light Co's plan to lend up to $6.5 million to its subsidiary, the Washington Water Power Co (EW, July 10, p 14).

The formal request for hearings was made by Goldman, Sachs & Co, Gerstley, Sunstein & Co and others of a group of American stockholders. The request indicated the group would challenge American's retention of the cash it proposes to lend Washington Water Power. The group is one of several seeking early dissolution of American and the distribution of its cash to its stockholders.

Other requests for hearings on the loan are considered imminent. In recent proceedings before the commission, counsel of Stockholder H. Lane Ogle attacked the proposed loan. American announced the funds would be used to call preferred stock and to help finance WWP's construction program. But Ogle's attorney held that "there is no impelling reason to call such stock and cause an increase in the short-term indebtedness of Washington."

It was contended that WWP could make "orderly arrangements for financing its construction program" by selling bonds and using earned surplus and depreciation funds.

The Washington State Public Service Commission, which must pass on the proposed loan, has not yet acted. But it has advised SEC that the plan raises a "question of increasing control of American over Washington Water Power."

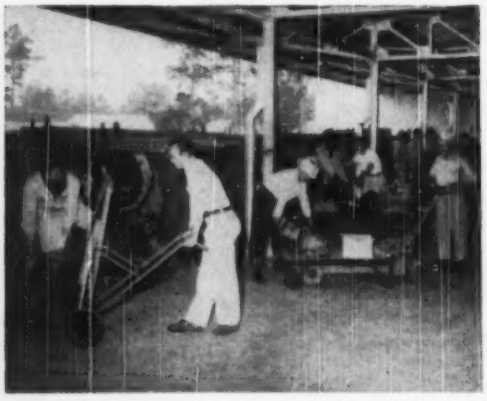


BERRY SERVICE CENTER of the Houston Lighting & Power Co is a modernistic appearing building which makes an attractive appearance. The center was constructed to serve the northern section of the Texas city. Houston L&P now serves 300,000 customers

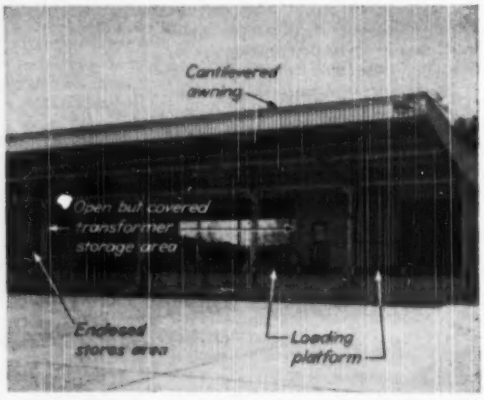
Better Service for Houston

TRUCKS are loaded from the dock side of the main building. Note the use of specially designed equipment for handling transformers

POLE YARD is arranged so that the unloading is from one side and the loading from the other. This assures use of older poles first



CABLE is stored in a fenced and concrete-paved cable and reel storage area. A truck with derrick loads the reels on the other trucks



SIDE VIEW of the building shows the truck loading area. Equipment and supplies can be brought in by rail on other side of structure

Area Service Centers Speed System Expansion

Houston Lighting & Power Co is meeting many of the knotty construction and maintenance problems arising from rapid system growth with area service centers. The idea isn't new. But the special facilities and equipment with which Houston L & P has rigged its centers make them among the most modern and efficient in the country.

The company now has four such buildings, three in outlying areas within a radius of 30 miles of Houston. The fourth serves the company's principal underground service area in Houston proper.

Berry Service Center, pictured on the opposite page, serves the northern section of the city. Among its features are special facilities for handling materials brought in by a railroad spur line. The floor of the main building is railroad car and truck height (4 ft above finished yard grade). The tracks in the rear serve the material storage areas in the building as well as the pole yard located in a 50-ft esplanade between two 30-foot concrete driveways.

Flow of material and equipment is generally through the enclosed stores area and the open, roofed transformer storage area to the truck loading dock in front of the building. The truck dock and parking area is sheltered by a cantilevered awning. This arrangement and the use of portable boxes and lift trucks permit the storekeeper to fill material orders for the line trucks at night.

The main building also provides a hot-stick storage room with controlled air conditions, a substation maintenance shop, first aid facilities, shower and locker rooms, offices for line foremen and the division supervisor and an auditorium.

•

Lighting Contract Granted

The Mansfield, Ohio, City Council has granted Ohio Edison Co a five year contract to supply electricity for the city's street lighting. The power company will revamp the lighting system completely without charge. Although Mansfield's lighting cost will be increased there will be large discounts.

•

Town Rejects Franchise

By a vote of 252 to 187, Elkader, Iowa, residents have refused to authorize a 15-year extension of the franchise held by Interstate Power Co. The firm's present franchise to supply the city with electrical power expires July 22.

Federal Water Policy Is Criticized as 'Haphazard' by Engineering Body

PUBLIC SPENDING for water resources development, including hydroelectric projects, now runs into billions of dollars annually. But the nation isn't getting its money's worth because of the "haphazard" way in which numerous agencies plan and build various types of projects.

So charges the Engineers Joint Council in recent recommendations to President Truman's Water Resources Policy Commission.

EJC, an organization of the five national engineering societies (civil, mining and metallurgical, mechanical, electrical, and chemical) sharply criticized existing federal water policy. And it urged virtually complete revision of the government's approach to resource development.

Asks New Start

The complaints were not new. Like the Hoover Commission and, more recently, a number of business organizations, EJC listed the overlapping functions of federal water agencies, inadequate planning of projects, Congressional "pork barrel" tactics, lack of coordination with other national programs and requirements, and muddling of social and water policies. It suggested that the whole mess be scrapped and the government start afresh. The starting point: A "realistic" federal water policy.

Crux of such a policy, EJC contended, should be the justification of all water projects on a dollars-and-cents basis—or the nearest possible approach to it. This is essential because of two considerations: First, public money is "limited in availability." And, second, water projects compete for this money with other public needs, like highways, schools, and hospitals.

Terms Projects Unsound

But the "present rate" of federal planning and authorization of water projects is "excessive and economically unsound." In the scramble to build pet projects standards of need and feasibility have gone by the boards. In the past 20 years there has been "a surprising degradation in the application of any criteria to water resources development." This has lead to "chaotic and indiscriminate expenditures, in which the good and bad projects are indistinguishable."

EJC conceded that some benefits of water projects, especially multi-purpose developments, could not easily be evaluated. But it insisted that intangibles could—and should—be given weight even if the main test of each project depended on how it stacked up against "measurable, quantitative criteria."

EJC took several controversial bulls by the horns in its general recommendations. It urged that tax payments be continued on lands taken for federal projects and that taxes be included in cost estimates. Other important proposals included:

- Authorization of all projects only by Congress, with the original authorizations placing a ceiling on project costs.
- Return to the Treasury of all project revenues for disbursement only by appropriation.
- Disclosure of all subsidies to beneficiaries of projects.
- Justification of each project individually—with no lumping of projects in basin accounts to permit revenues of good projects to carry weak sisters. Benefit-to-cost ratios of at least 4 to 3 and as much as 2 to 1 where exact estimates are impossible.
- Establishment of a board of analysis, as recommended by the Hoover Commission, to review all projects before their authorization by Congress.
- Financing by local sources—public or private—wherever feasible.

Horner Headed Panel

The report was prepared under direction of a panel headed by W. W. Horner, St. Louis consulting engineer and a past president of ASCE. Other panel members included E. L. Clark, AIMME; R. D. Hoak, AICE; C. W. Mayott, AIEE, and W. F. Uhl, ASME. The panel was assisted by 75 experts in the various fields of water development, including both members and non-members of the five engineering societies sponsoring the study.

None of these experts was drawn from federal service. But about a third had experience on federal projects.

Index to be Available

ELECTRICAL WORLD's semi-annual index is being prepared and will be available this month. It may be obtained without charge. Address requests to ELECTRICAL WORLD, Editorial Office, 330 W. 42nd Street, New York 18, N. Y.

YIELDS (%) — Operating Electric Utility Securities

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1950									
July 6	2.65	2.67	2.76	3.81	4.02	4.38	5.31	6.47	7.52
June 22	2.63	2.65	2.75	3.77	3.98	4.34	5.07	5.95	6.91
END OF QTR.									
1st 1950	2.59	2.61	2.74	3.78	4.01	4.36	5.22	5.85	6.67
4th 1949	2.59	2.61	2.72	3.85	4.06	4.46	5.37	6.15	7.01
3rd 1949	2.61	2.65	2.77	3.88	4.15	4.54	5.55	6.67	7.51
2nd 1949	2.69	2.75	2.88	3.98	4.26	4.66	5.94	6.96	8.14

Data: Reis & Chandler, Inc.

4 Cities Plan Purchase of Puget Sound Facilities

Four cities in King County, all within 20 miles of Seattle, have retained a syndicate of Seattle investment houses to secure preliminary financial, legal, and underwriting advice toward proposed individual purchase of Puget Sound Power & Light Co properties in their immediate vicinities. Two more cities are considering similar action.

Auburn, Buckley, Sumner, and Enumclaw have signed up with a syndicate composed of Blythe & Co, Pacific Northwest Co, William P. Harper, and Bramhall & Stein. Kirkland and Renton have yet to reach a decision. Puyallup, in adjacent Pierce County, also is considering action.

Municipal purchase is an alternative to formation of a PUD to acquire Puget Power properties in King County outside the Seattle area. Seattle has indicated it may purchase company properties only within its city limits, certainly not beyond the area in which it now competes with Puget Power.

Businessmen in the various cities are reported to favor municipal purchase rather than formation of a PUD, claiming that tax benefits accruing to the cities would balance higher individual system construction costs. Elections would be necessary in each city in the event of purchase.

•

Two Michigan Utilities Announce Merger Plan

Consumers Power Co, serving most of southern Michigan outside Detroit, has contracted with Michigan Public Service Co to acquire all the assets of the latter. The agreement will go into effect upon approval by the Michigan Public Service Commission.

All Michigan Public Service stock will be taken over by Consumers in exchange for 106,200 share of Consumers common.

Consumers has also asked the commission to approve a plan under which present rates in Michigan Public Service territory, which are now about 25% higher than Consumers charges, would be reduced to the Consumers level. Proposed scaling down of rates would start immediately with a 6% cut; then a gradual reduction would follow over the next three years.

Michigan Public Service now operates in a 16-county area at the top of the lower Michigan peninsula.

•

Mountain States Granted Rate Cut for Competition

Mountain States Power Co has been given authority to readjust its rates to compete with the recently established municipal system at Springfield, Ore. Most rates will be cut.

"This company cannot be deprived of the right to meet competition by filing reduced rates where the loss is charged to the stockholders and not borne by the taxpayers," Oregon Public Utilities Commissioner George H. Flagg's order read. He said that in the case of real competition between a municipality and a public utility, the commission's only obligation is to see that the stockholders foot the bill.

FINANCIAL BRIEFS

Consolidated Edison Co of New York has asked the Public Service Commission for authority to merge two wholly owned subsidiaries, Westchester Lighting Co and Yonkers Light and Power Co. The merger would reduce the system to four companies, Con Ed, New York Steam Corp, Staten Island Edison Corp, and Consolidated Telegraph & Electrical Subway Co.

A special meeting of Connecticut Light & Power Co common and preferred shareholders has been called for Aug 8 to vote on a proposed four-for-one split of the common stock.

Stockholders of Southwestern Public Service Co will vote on a two-for-one split of the common stock Aug 1. The company now has 2.5 million shares outstanding. They also will consider charter amendments designed to modernize certain restrictions.

Transfer of the remaining assets of Commonwealth & Southern Corp to Southern Co rather than to Commonwealth's former stockholders has been approved by Federal Judge Paul Leahy in Wilmington. He dismissed petitions that sought to set aside the Securities and Exchange Commission order directing transfer of the assets as part of Commonwealth's final dissolution plan.

The United States Supreme Court has refused to review a protest by Consolidated Edison Co of New York on the New York Public Service Commission's order to cut electric rates by about $21.5 million annually.

The Securities and Exchange Commission granted Kansas Electric Cooperative, Inc, Topeka, a chance to protest at a recent hearing the proposed distribution of United Light & Railways Co's stock interest in Eastern Kansas Utilities, Inc, Fort Scott. The intervenor represented four Kansas operating co-ops which would like to buy Eastern Kansas facilities. None of the co-ops has a direct financial interest in either utility. In contrast, it took American Power & Light Co stockholders and two state commissions more than a month to get an SEC hearing on their objections to AP&L's financial policies.

Electrical Utility Financing—July 1-8

Company	Description	Amount of Offering (000)	Offering Price	Yield at Price to Public
Preferred				
Kentucky Utilities	30,000 sh 4¼% ($100) new money	$3,075	$102.50	4.63%

SCHEDULED

Bonds: Kentucky Utilities, 1st mtg, C, 1980 new money, $3.5 million.
Common: Offering by Middle West Corp—Central & South West Corp, 12,232 sh; Central Illinois Public Service, 6,116 sh; Public Service of Indiana, 1,631 sh; Wisconsin Power & Light, 3,058 sh; Kentucky Utilities, 6,116 sh—holding company divestment, $500,000.

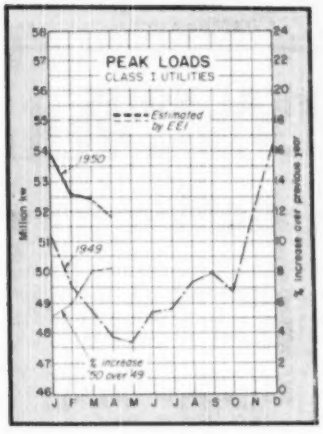
Energy Sales for April 9.8% Higher Than in '49

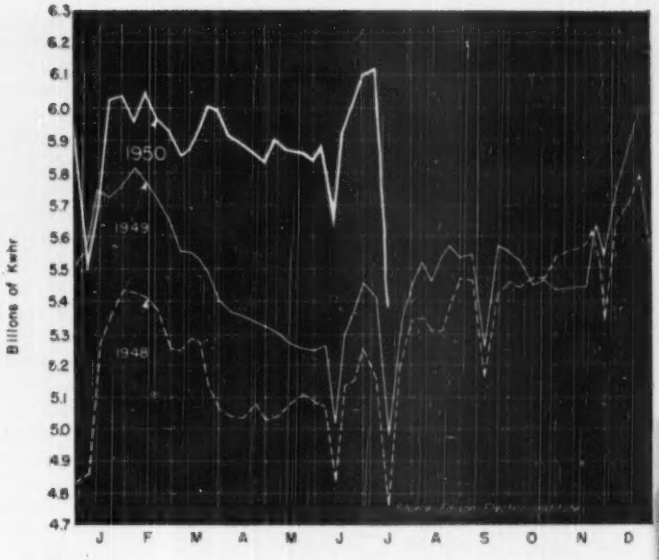
Electric energy sales in April were 9.8% higher than those for the same month last year.

Edison Electric Institute reported April sales to ultimate customers were 22,396,907,000 kwhr. compared to 20,410,121,000 in April, 1949. Revenue from ultimate customers totaled $410,075,600 or 9.4% above the $374,735,300 received in April last year.

Classification of Sales, April

Kilowatthour Sales April	Million Kwhr 1950	1949	Percent Change
Residential or domestic	5,521	4,760	+16.0
Rural (Distinct rural rates)	605	532	+13.8
Commercial or industrial			
Small light and power	3,986	3,685	+ 8.2
Large light and power	10,930	10,125	+ 8.0
Street and highway lighting	221	205	+ 7.9
Other public authorities	581	522	+11.3
Railways and railroads			
Street and interurban	287	312	— 7.9
Electrified steam railroads	209	212	— 1.6
Interdepartmental	55	48	+16.2
Total to ultimate customer	22,397	20,401	+ 9.8





Output Week Ended July 8—5,379,924,000 Kwhr

Weekly Output, Millions Kwhr

1950		1949		1948	
July 8	5,380	July 9	4,982	July 10	4,760
July 1	6,115	July 2	5,410	July 3	5,166
June 24	6,102	June 25	5,466	June 26	5,257
June 17	6,012	June 18	5,373	June 19	5,159
June 10	5,921	June 11	5,300	June 12	5,132
June 3	5,632	June 4	5,018	June 5	4,845
May 27	5,894	May 28	5,270	May 29	5,076
May 20	5,845	May 21	5,255	May 22	5,085
May 13	5,864	May 14	5,257	May 15	5,109
May 6	5,872	May 7	5,284	May 8	5,087

Percent Change from Previous Year

	July 8	July 1	June 24
New England	+ 5.1	+17.2	+11.5
Mid-Atlantic	+ 8.8	+12.9	+10.9
Central Industrial	+ 7.6	+15.5	+13.6
West Central	+ 1.4	+ 9.1	+ 9.7
Southeast	+ 9.8	+17.0	+17.4
South Central	+10.7	+13.1	+13.8
Rocky Mountain	+ 6.5	+ 9.6	+ 7.3
Pacific Coast	+ 8.9	+ 5.6	+ 3.4
Total United States	+ 8.0	+13.0	+11.6

MEETINGS

Instrument Society of America
National Conference and Exhibit, Buffalo Auditorium, Buffalo, N. Y., September 11-15.

Northwest Public Power Association
Convention, Portland Hotel, Portland, Ore., September 13-15.

American Society of Mechanical Engineers
Fall meeting, Hotel Sheraton, Worcester, Mass., September 19-21.

Public Utilities Association of the Virginias
Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., September 22-23.

Canadian Electrical Manufacturers Association
Annual Meeting, General Brock Hotel, Niagara Falls, Ontario, Can., September 27-29.

National Television and Electrical Living Show
Chicago Coliseum, Chicago, Ill., September 29-October 8.

Pennsylvania Electric Association
Transmission and Distribution Committee, Irem Temple Country Club, Dallas, Pa., October 5-6.

Indiana Electric Association
Annual Convention, French Lick Springs Hotel, French Lick, Ind., October 11-13.

International Association of Electrical Leagues
Annual Conference, Copley Plaza Hotel, Boston, Mass., October 11-14.

★**National Electrical Contractors Association**
Annual Convention, Hotel Biltmore, Los Angeles, Calif., October 17-20.

American Institute of Electrical Engineers
Middle Eastern District Meeting, Lord Baltimore Hotel, Baltimore, Md., October 3-5; Fall General Meeting, Skirvin Hotel, Oklahoma City, Okla., October 23-27.

★ Addition This Week

Changes in Capacity Reported to Federal Power Commission

PLANT ADDITIONS DURING MAY

Utility	Plant	Fuel	Capacity (Kw)
Hatfield Municipal Electric Department	Hatfield, Pa.	IC	300
Indianapolis Power & Light Co	White River	S	40,000
Wisconsin River Power Co	Peterwell	H	20,000
Nantahala Power & Light Co	Tuckaseges, N. C.	H	3,000
Army Engineers	Allatoona, Ga.	H	36,000
Louisiana Power & Light Co	Montgomery	IC	190
Public Service Co of Oklahoma	Weleetka	S	30,000
Oklahoma Gas & Electric Co	Mustang	S	50,000
Utah Power & Light Co	Ovem	S	44,000
Pacific Gas & Electric Co (Calif.)	Moss Landing	S	100,000

PLANT RETIREMENTS DURING MAY

Consumers Power Co	Greenville, Mich.	H	300
Dubois Public Service Co	Dubois, Wyo.	H	88
Peach Springs Light & Power Co	Peach Springs, Ariz.	IC	50

H—Hydro, IC—Internal Combustion, S—Steam
United States Capacity as of June 1, 1950—Steam, 45,840,896 kw; Internal Combustion, 1,831,912 kw; Hydro, 17,217,840 kw; Total, 64,890,648 kw.

Workers Get Pay Boost

Employees of Public Service Co of Indiana received a 5% wage increase, ranging from 7½ to 9¢ an hour, under an agreement signed June 29 to run for the next two years. Agreement also calls for general improvement in a hospital and health program for employees.

WASHINGTON COMMENT

RONALD D. ROSS

FEDERAL DEPARTMENTS and agencies are suffering from a failure to keep top-level, policy-making jobs filled. Call it what you will, the capital's executive "help wanted" rolls are costing dollars and perhaps more.

As this was written, the Atomic Energy Commission has only three members. Further, the commission has been without a chairman for some five months. Interior has had no undersecretary for more than seven months. A national science foundation, finally approved after five years' pleading by scientists, has not begun to function because 24 board members and a director are yet to be named. And elsewhere in the government, major departmental and regulatory positions were vacant.

Nor was this a momentary, new situation. One period last year found the Securities and Exchange Commission with only three members. For a third of the year, there was a vacancy at the Federal Power Commission as Congress and the President clashed over the renomination of Leland Olds. Perhaps the most shocking federal vacancy was the chairmanship of the National Security Resources Board, unfilled for more than a year. W. Stuart Symington has only recently taken over that job for which a Senate committee rejected Mon C. Wallgren, now chairman of FPC.

It's not hard to find reasons for the vacancies. High positions in the government may demand long hours of hard work coupled with staggering responsibilities. Pay is low compared with the salaries offered for any nearly comparable positions in business or industry. The prestige or honor once claimed for important federal posts is likely to be replaced by blasts from Congress or brickbats from the press. And for any high government job, there are a limited number of persons with the background and other qualifications.

The same factors that make vacancies hard to fill also create them. Officials of experience and ability too often leave the government for more attractive non-federal positions.

President Truman is well aware of the problem. He recently established a White House group to work up a register of American leaders of policy-making calibre. This catalog would be designed to help spot possible appointees for some of the federal vacancies as they occur. It's easy to sympathize with the President's personnel difficulties.

The Senate, too, deserves praise for its conscientious effort to weed out appointees who are ill-qualified for the jobs for which they have been named.

On the other hand, both the President and the Senate must accept some blame for the costly delays in filling these jobs. Nominations have not been made as promptly as they might, it would appear in some cases. In others, unpopular selections seem to have been backed in the face of seemingly certain defeat. Party politics and personalities have delayed nominations—as well as making government service less attractive.

In the present, tense international situation, the long period during which NSRB was without a full-time chairman has not helped our preparedness.

Greater peril could come from the failure to provide full leadership for the nation's atomic energy program. Policy decisions must be made with speed and wisdom as AEC moves ahead with one foot in the unknown. A full commission with a capable chairman is essential if we are to maintain military preparedness, to say nothing of furthering peaceful development of atomic energy.

In this connection the private electric utility industry might be able to provide a leader to take the reins at AEC. The first chairman, David E. Lilienthal, came to the commission from a major federal power enterprise, TVA. And the industry's record achievements in the past decade certainly indicate an ability to meet the unprecedented challenges which are AEC's fare.

In any event, AEC's chairmanship and other vacant federal policy posts require prompt action, both at the White House and the Capitol.

TECHNICAL NOTES

ARCHER E. KNOWLTON

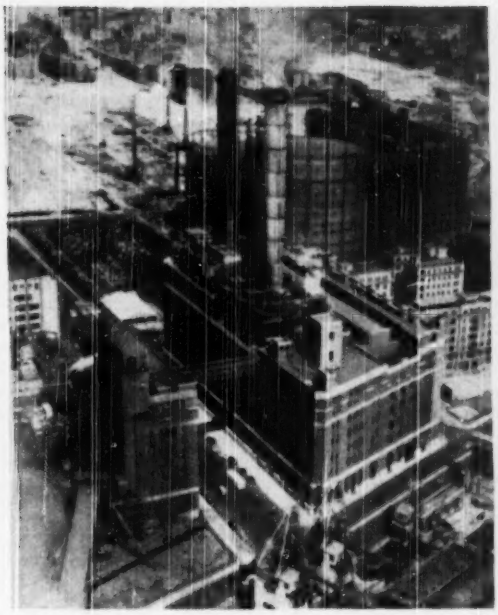
(From papers presented at the recent Conference Internationale des Grand Reseaux Electrique a Haute Tension)

Transmission cost per kwhr in Sweden for a 1000-km 380-kv line with two 592 sq mm conductors line are estimated to be 52% as much as for a 200-km 220-kv line. (405)

Transformer costs per kva in Sweden for 220 kv with 2 and 3 windings and 380 kv likewise are in the ratios of 100, 132, 105 and 145; 380-kv transformer bays in switching stations are 2.72 times as costly as 220 kv; the entire station is almost exactly doubled. (405)

Costs for transmission in Sweden run in about the proportions of 100, 111, 135 and 162 for 220 kv (592 sq mm), 220 kv (2 x 328 sq mm, 330 kv (903) sq mm) and 380 kv (2 x 592 sq mm); double conductors are 45 cm apart. (405)

Modern arrester dependability has led to revised U. S. A. schedules of basic impulse insulation levels; with effective neutral grounding the trend is toward 80% arresters for 115-161 kv and 75% for 230 kv and up. (413)



EAST RIVER STATION at left of which is site of new station for 69-kv subtransmission. At right, new station in construction

New York Network Supplied at 69 Kv From Isolated-Phase Station

Subtransmission at 69 kv from East River station to Manhattan network areas reduces number of feeders 80%. . . . Use of 69-kv outdoor metalclad switchgear cuts building cost. . . . Resulting over-all savings are 30%.

A. M. deBELLIS, Inside Plant Engineer, Consolidated Edison Co of N. Y., Inc

ADOPTION of 69 kv as the subtransmission voltage for supplying distribution stations in network areas, and the use of 69-kv outdoor isolated-phase, metalclad buses and circuit breakers at the East River generating station resulted in pronounced over-all savings in station as well as subtransmission costs.

Estimates for the 69-kv system when compared with the 13.2-kv system show savings in capital investments as follows: 85% for building structure, 40% for switches and buses, and 50% for subtransmission. If the higher cost of transformer equipment and the higher transformer losses inherent to the 69-kv system are included, the over-all saving is of the order of 30%.

During the last decade the ac low-voltage network in the Consolidated Edison System grew from a total of 12 network areas with a load of 670 Mw in 1937 to a total of 16 areas and a load of 1,230 Mw in 1948. In 1937, a system of load segregation was put into effect because operating experience had demonstrated that a large network system to be suitable for independent restarting in case of shutdown should be area-segregated both primary and secondary. Capacity of the individual areas was selected at

Adapted from author's paper, entitled "Consolidated Edison Co's New East River Generating Station Supplies 69-kv Bulk Power to New York Load Centers," presented before Electrical Equipment Committee of Edison Electric Institute at Schenectady, N. Y.

from 5 to 10% of the system's peak load which meant capacities of from 50 to 75 Mw for the networks supplied at 13.2 kv and from 75 to 150 Mw for the 27-kv networks. For each area 8 to 12 feeders were to supply the distribution transformers at generator voltage directly from the generating station.

As the generating capacity and the interstation tie systems were expanded to cope with the increased load requirements, it became possible and economical to increase the megawatt rating of the segregated load area. Today the planning is for individual newtork area loads of the order of 140 Mw for Manhattan which is supplied at 13.2 kv, and 300 Mw for Queens which is supplied at 27 kv.

Distance from the East River station to the Manhattan network areas are relatively short — one to two miles. It might be expected that as in the past 13.2 kv, would have proved the most economical voltage to supply these areas.

With the loads of the order of 140 Mw, the megawatt-miles are fairly high in spite of the short distances. Enhanced by this fact, present economic conditions have justified the adoption of bulk power transmission at 69 kv from East River to the Manhattan network areas. Selection of this voltage has had a major influence on the design of the East River Station.

East River Development . . . The new East River station will supply 60-cycle power at 69 kv to distribution substations located in the network areas, and according to present plans, will have an ultimate installed generating capacity of about 700 Mw, in four or five generator units. It is expected that this station will eventually supply all of lower Manhattan and part of middle Manhattan (see Fig 1).

Ultimately, the new and the present East River stations, although electrically distinct in every respect, will represent a concentration of power under one roof of approximately 1,100 Mw.

Economic Aspects . . . A breakdown of the total cost of power supply from the generator terminals to the load centers was made into three major investment elements, namely, the building structures for the electrical galleries, the switching equipment and the subtransmission. This indicated that (for Manhattan) the building structures and the equipment accounted for 75% of the total investment. Of this amount, approximately 30% represented building costs and 70% the cost of switching and miscellaneous electrical equipment which constitute the electrical galleries.

In past designs various steps towards lowering costs had been taken, such as the use of single buses, the omission of selector or series breakers, the use of metalclad construction and factory assembled and wired equipment.

Simplification of building structures had been brought about by the use of isolated phase metalclad equipment and air blast breakers. Further simplifications in the electrical installation did not present the opportunity for substantial savings without sacrificing station reliability.

Due to space limitations that invariably exist at our generating stations it has traditionally been necessary to build multi-story switch galleries. Such construction obviously represents a large investment.

Some changes in basic design were needed if we were to materially reduce the cost of future electrical galleries and still provide equal or better service to the load. A change was made in their functional character by decentralization of the switching and bus equipment to obtain the following advantages:

1. To eliminate multi-story gallery buildings or the entire building structure if possible.

2. To reduce to a minimum the use of high-ampere capacity switching and bus equipment and high-interrupting capacity circuit breakers at low voltage.

3. To simplify the outgoing cable system by using 3-conductor cables of the highest voltage rating which could be accommodated in our duct system.

4. To design the electrical galleries on the "pay-as-you-go" principle, namely, provide the necessary flexi-

FIG 1—LONG RANGE PLAN for supply of 69-kv bulk power from East River Station

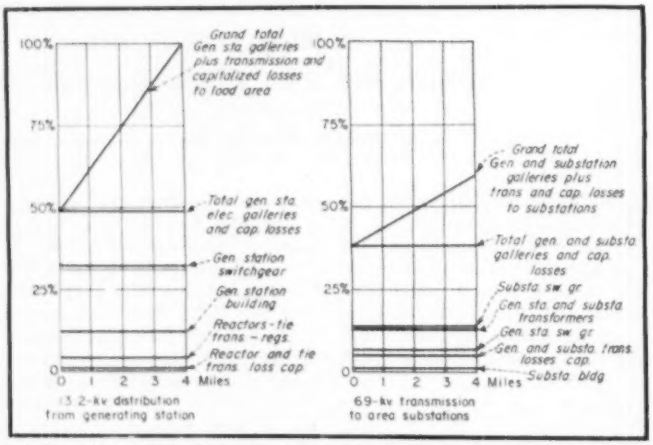

100%
75%
50%
25%
0
Grand total Gen. sta. galleries plus transmission and capitalized losses to load area
Total gen. sta. elec. galleries and cap. losses
Gen. station switchgear
Gen. station building
Reactors-tie trans.-regs.
Reactor and tie trans. loss cap.
0 1 2 3 4 Miles
13.2-kv distribution from generating station
Grand total Gen. and substation galleries plus trans. and cap. losses to substations
Total gen. and substa. galleries and cap. losses
Substa. sw. gr.
Gen. sta. and substa. transformers
Gen. sta. sw. gr.
Gen. and substa. trans. losses cap.
Substa. bldg.
69-kv transmission to area substations

FIG 2—COST ESTIMATES of plans for East River development based on (A) 13.2-kv distribution from generating station and (B) 69-kv transmission to area substations

bility for future load growth without advance plant investment.

The design adopted for East River consists of a much simplified generating station switch gallery from which bulk power will be transmitted at 69 kv to a number of distributing substations located at the load.

From these substations the required number of 13.2-kv distribution feeders will supply their respective networks in accordance with our established practice. The generating station switching and buses will be 69-kv equipment, outdoors, and the substation switching, simplified by the omission of high capacity breakers and current limiting reactors, will be housed in simple one-story structures.

By using 69-kv subtransmission instead of 13.2-kv the number of outgoing feeders from the generating station is reduced by 80%.

Comparative costs of the conventional 13.2-kv and the new 69-kv designs for the East River station are shown in Fig 2.

With all elements of labor and material costs taken into consideration, our estimates, based on a subtransmission distance of two miles, have indicated savings in capital investment in favor of the 69-kv system of the following order of magnitude: Building Structures 85%; Switch and Buses 40%; Subtransmission 50%.

Cost of the transformer capacity required for the double transformation on this 69-kv system, reduces the above savings. But, the combined cost of switching, buses and transformers shows a differential of approximately 10% in favor of the 69-kv system.

Total saving in capital investment per kw of installed capacity may be of the order of 30%.

Accompanying table shows comparative over-all cost percentages and includes capitalized losses of equipment and subtransmission. Some of the unit costs which were instrumental in establishing 69 kv as the most economical voltage level for our application are shown on the charts in Fig. 13.

No attempt has been made to evaluate any advantages which may be derived by the elimination of phase angle between distribution buses or by the independent voltage regulation in the network areas which the 69-kv system provides.

Consolidated Edison pioneered in

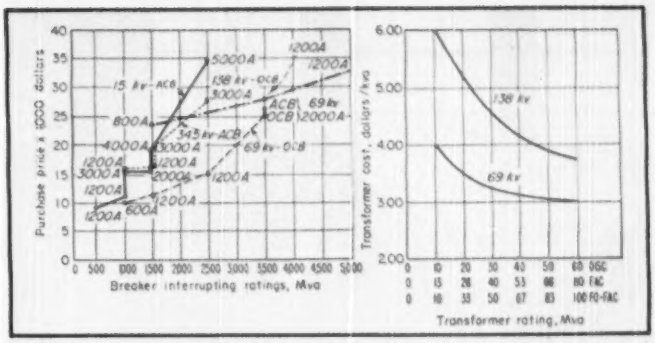


FIG 3—UNIT COST COMPARISONS: (A) Power circuit breakers, (B) 138-kv and 69-kv transformers for triple rated units without tap changing under load

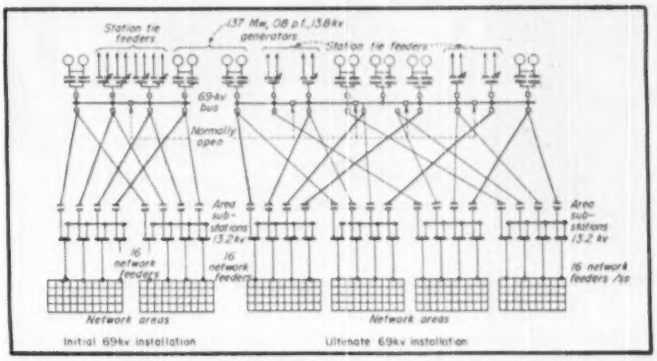


FIG 4—69-KV SYSTEM DEVELOPMENT: First stage, at left, consists of two generator units, 13.2-69 kv transformers, 69-kv subtransmission, two 69-13.2 kv distribution substations (only one substation in initial installation), and network connections

metalclad isolated phase equipment. Accordingly, in the case of East River station, the 69-kv system has been made possible, to a large degree, by recent developments in isolated phase outdoor metalclad switchgear and bus equipment of this voltage class.

Fundamental Plan of 69-kv System . . . Basic design features of the East River development may be summarized as follows:

1. The generating station will have an ultimate capacity of approximately 700 Mw and will supply bulk power at 69 kv to four ac low-voltage network areas. Each area will be supplied by four 69-kv feeders.

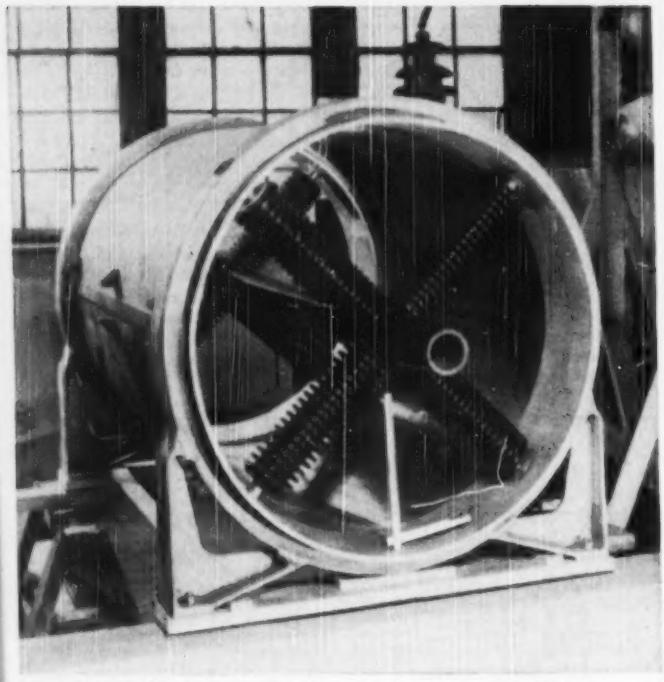
2. One distributing substation will be provided for each network area where power will be transformed to 13.2 kv for primary distribution to the area. Network areas will be segregated both primary and secondary, and will have an ultimate capacity of the order of 140 Mw.

3. At the generating station the bus arrangement and the rating of the equipment have been chosen on the basis that there will be no dropping of area load because of any one of the following contingencies:

(a) Loss of two generator units; (b) loss of all interstation tie feeder capacity; (c) loss of one generator unit and one-half of the tie feeder capacity; (d) loss of one 69-kv bus section; and (e) loss of two 69-kv feeders to any substation.

All busing and switching at generator voltage have been omitted and a minimum of 69-kv switching has been used.

4. Interstation tie feeders will be provided to two adjacent generating stations, Waterside and Hudson Avenue. Tie capacity will be adequate to support the East River bus in case of



ISOLATED-PHASE BUS, metalclad, is 36-in. ID, designed for 69 kv, 1,500 amp

the loss of two generator units. Regulating equipment on the ties will permit power interchange.

5. Short circuit duty on the 69-kv equipment is kept within reasonable limits at the generating station by operating the station buses in segregated elements. Normally, the only connections between generator units will be through the 13.2-kv synchronizing buses at the substations, and through the interstation ties.

6. Substation duplicate, in general, the switching and bus arrangement and segregation of our most recent generating stations.

The 13.2-kv feeder buses for a given network are held rigidly together in voltage and phase and, therefore, have eliminated the phase angle problem of previous installations.

Substation bus arrangement and rating of the equipment have been chosen on the basis that no load will be dropped because of the following contingencies: (a) Loss of one of four major feeder bus sections; (b) loss of two 69-kv incoming feeders or two main transformer banks.

At the substations short circuit duty on the 13.2-kv equipment is kept within reasonable limits, although no reactors are used, by a choice of relatively higher than normal transformer reactances.

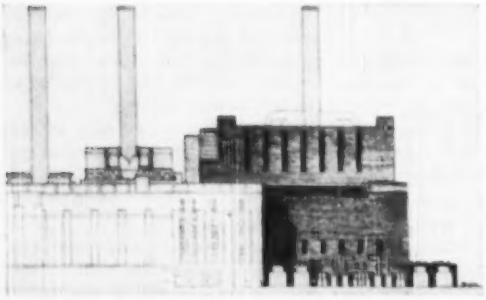
7. With regard to system stability, this system does not present any particular problem because all generators at East River will be closely coupled with each other and with other generating stations. Also, high speed relaying is used throughout.

The only faults which, from a stability standpoint, need be considered are phase-to-phase faults on the 69-kv buses or feeders. Should these faults fail to clear because of protective equipment failure, then an out-of-step operation of the generator unit directly connected to the fault would occur. While such a fault would result in the loss of one unit, the remaining generators would maintain synchronism with each other.

8. It is believed that voltage dips from either 69-kv or 13.2-kv feeder faults will not be troublesome. Experience with our 13.2-kv and 27-kv shielded cable system has shown that approximately 75% of our feeder short circuits begin "line to ground." Neutral reactors installed in the 13.2-kv winding of the substation transformers will limit the voltage drop in the low-tension network to approximately 25% for these short circuits.

Three-phase cable faults will be cleared in about 0.2 sec or less and it is our opinion that this should cause no serious difficulty. Experience at Jamaica substation for 1.5 years substantiates our assumptions.

With respect to the performance of



NEW EQUIPMENT, 69-kv outdoor, is at right of present station

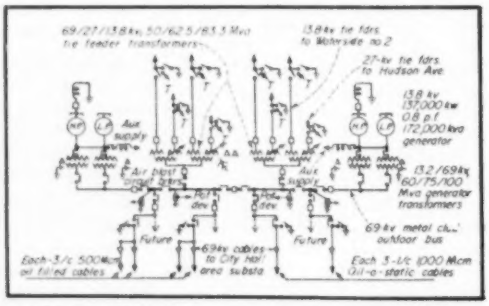

69/27/13.8 kv, 50/62.5/83.3 Mva tie feeder transformers
13.8-kv tie fdrs to Waterside no.2
27-kv tie fdrs to Hudson Ave.
13.8 kv 137,000 kw 0.8 p.f. 172,000 kva generator
Aux supply
Air blast transformers
Aux supply
13.2/69 kv 60/75/100 Mva generator transformers
Future
69-kv cables to City hall area substa
Future
69-kv metal clad outdoor bus
Each 3-1/c 500 Mcm oil filled cables
Each 3-1/c 1000 Mcm Oil-o-static cables

FIG 5—CONNECTIONS at new station for initial installation

Comparative Cost Percentages

Basis
- Total Area Peak Load . . . 240 Mw
- Subtransmission Distance . . . 2 Miles
- 69-Kv Subtransmission Feeders . . . Total of 8
  - Four Feeders each Consisting of two 3x500-Mcm Oil-Filled Cables
  - Four Feeders each Consisting of a 3x1,000-Mcm Pressure-Pipe Type Cable
- 13.2-Kv Subtransmission Feeders . . . Total of 36
  - Each Feeder Consisting of 3x800-Mcm Cable

Item	Cost Percent 13.2 Kv Plan	69 Kv Plan
Fixed Capital		
Generating Station Building	16.5	0.0
Substation Building	0.0	1.3
Generating Station Switchgear	41.8	8.3
Substation Switchgear	0.0	17.3
Generating Station and Substation transformers, regulators and reactors	5.2	17.3
Subtransmission	31.3	15.1
Capitalized Losses		
Reactors, transformers, regulators	0.8	6.5
Subtransmission	4.4	0.7
Total	100	66.5

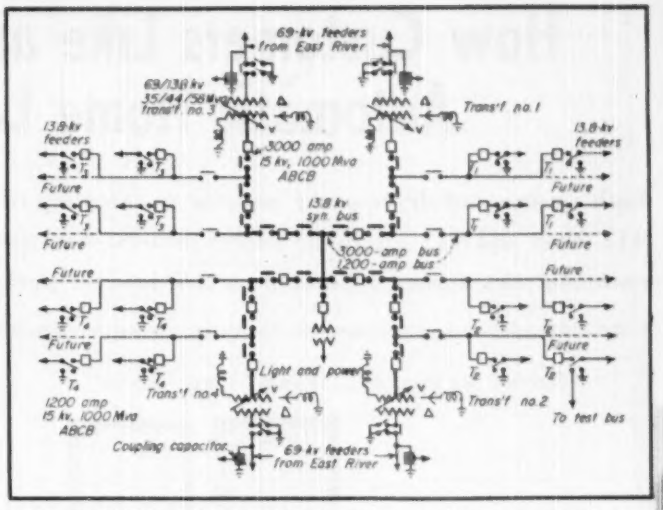


FIG 6—SIMPLIFIED CONNECTIONS of probable standard-design area substation

the 69-kv cable system, oil-filled shielded cables will be used and if our experience with our 132-kv cable system where no operating failures have occurred for approximately 20 years is any criterion, cable faults will cause a minimum of trouble to the system.

9. The subtransmission system will consist of four 69-kv underground circuits from the generating station to each substation. Any two of the 69-kv circuits feeding different substations will be paired on one breaker position at the generating station. Three-conductor, oil-filled shielded cable will be used on two 69-kv feeders and pressure pipe cable systems will be used on the other two feeders to each substation. A simplified diagram of the initial 69-kv system and of the expected ultimate development are shown in Fig 4.

Essentially, the 69-kv bus system consists of a number of uniform elements each comprising a generator unit, an interstation tie feeder and two radial feeders to the substations. For all practical purposes, this system represents a synchronized-at-the-load arrangement.

First Stage of Development . . . Initial installation of the East River development consists of two generator units and one distribution substation.

Each turbine will be supplied by one boiler with a maximum rating of 1,000,000 lb per hr steam at 1,500 psi and 1,000 F. Both generating units are cross-compound and have 3,600 rpm and 1,800 rpm generators. This combination has a nameplate rating of 120 Mw, a guaranteed maximum capability of 137 Mw and under certain operating conditions could deliver 151 Mw.

Each generator transformer will be metalclad, rated 3-ph, 60/75/100 Mva continuous, 13.2-69 kv, with two plus and two minus 2.5% taps on the 69-kv winding.

Interstation tie transformers will be metalclad, 3-ph, 3-winding, rated 50/62.5/83.33 Mva continuous, 69-13.5-27 kv with taps on the 69-kv winding. The 27-kv winding will be equipped with tap-changing-under-load equipment with a range of plus or minus 14%.

All circuit breakers are air-blast, 69 kv, 2,000 amp, 3,500 Mva, metalclad, outdoor type, phase isolated.

All 69-kv buses and connections, including disconnecting switches, are 1,500 amp, metalclad, outdoor type, based on 30 C rise over a 40 C ambient temperature.

Metalclad buses, rated 15 kv, 4,000 amp, will be used for all generator connections, from the generator terminals to the transformer terminals.

The step-up generator transformers and the 69-kv switching are located outdoors adjacent to the present switch gallery.

Electrical auxiliaries will be supplied directly from the generator terminals and from the 13.2-kv station tie feeders. Utilization voltages are 440 v and 120/208 v. Load center substations are rated 1,250 kva, 13.2 kv-440 v, and 937 kva, 13.2 kv-120/208 v. Transformers are sealed tank, dry type, nitrogen filled.

All of the bus and switching equipment for the 13.2-kv auxiliary supply is metalclad. Low voltage switchgear units are outdoor type, metalclad, totally enclosed with no means for external ventilation.

Distribution Substation . . . The first distribution substation to be built, known as City Hall substation, supplies the City Hall network which covers an area of approximately 0.5 sq miles.

Four 69-kv feeders supply four metalclad transformers which are rated 3 ph, 65-13.6 kv, 35/43.75/58.45 Mva continuous. These transformers serve eight 13.2-kv minor load bus sections grouped into four major sections. A total of 16 outgoing 13.2-kv network feeders are installed initially. Provision is made for eight additional feeders.

The substation will normally be operated by supervisory control from the generating station. Provision is made for local operation in case of emergency.

How Customers Like and Use the Automatic Home Laundry

Both washer and dryer prove popular in sampling of 311 dryer and 421 automatic washer owners. Average customer uses washer 3.2 and dryer 2.7 days per week

E. O. GEORGE
Asst Commercial Manager
The Detroit Edison Co, Detroit

CLOTHES DRYERS are used an average of 3.2 days per week and automatic washers 2.7 days per week according to information revealed by a study made by the Detroit Edison Co. The Detroit study was based on interviews with owners of 311 clothes dryers and 421 automatic electric washers plus data from recording watthour and demand meters which were installed in a group of representative homes. Other information revealed by the study will be valuable in the direction of load-building activities.

Customer Acceptances . . . First findings of the study were concerned with customer acceptance and customer use. The electric clothes dryer enjoys an unusually high degree of customer acceptance–96.1%. There is somewhat less acceptance for the automatic electric washer–81.5%. This latter figure would be higher, however, if interviews were made only on recent purchases of washers.

Leading benefits reported by customers included 129 comments on the texture of the clothes—they were whiter, had a cleaner smell, no fading, no clothes pin marks, clothes were softer, fluffier, particularly towels, mats, and bedspreads.

Second largest group of benefits were concerned with less work, such as—no hanging up of clothes, easier and less ironing, clothes dried evenly, no sprinkling, no lifting and carrying of baskets, no worry about the weather, space-saving.

This list is of value in the preparation of promotional material, but of even greater importance are the dislikes, although not representing a high percentage. Dislikes were directed towards moisture and steam, lint, takes too long to dry, harder to iron, starched clothes have lint, shrinkage, mixed clothes, twisted buttons, and can't do woolens.

Survey Replies to "Whats" and "Hows"

	CLOTHES DRYERS	AUTOMATIC WASHERS
How Do Customers Like Them?		
Like	96.1%	81.5%
Dislike	3.9	8.9
Undecided	0.0	9.6
What are Income Levels of Owners?		
Upper	22%	21%
Upper Middle	30	32
Middle	41	37
Lower Middle	7	9
Lower	0	1
	100%	100%
How Big Is Owner's Family?		
Adults	2.8	2.5
Children	1.5	1.2
Infants	0.3	0.2
Full-Time Domestics	0.2	0.1
	4.8	4.0
What Time of Day Are They Used?		
A. M.	48.4%	56.1%
P. M.	17.1	19.3
Both	34.5	24.6
What Days of Week Are They Used?		
Monday	68.3%	70.0%
Tuesday	30.1	19.5
Wednesday	29.4	24.4
Thursday	28.4	19.1
Friday	33.7	34.3
Saturday	17.6	24.0
Sunday	10.5	4.9
Every day	7.5	0.0
None in particular	10.8	17.8
Bad weather only	1.6	0.0

In order of frequency the likes and benefits expressed by owners of automatic washers were: time-saving, labor-saving, can do other work while washing, automatic rinsing, dries clothes very well, don't have hands in water, don't have to handle wet clothes, and, at the bottom of the list, clothes are clean, easier to operate.

Dislikes which gave automatic clothes washers a lower mark on customer acceptance were: clothes not clean, defective, lint, can't be used for small loads, and, at the bottom of the list, too much hot water used.

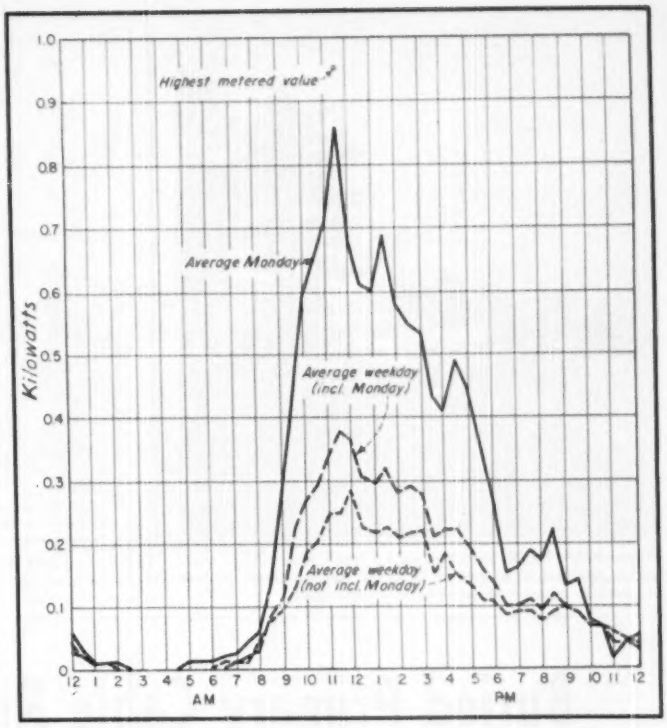
Income Distribution . . . Twenty-two per cent of the automatic laundry equipment is installed in the group representing 8% of the customers. Highest percentage of ownership is in the middle-income group. Less than 10% of the installations are in the lower-middle and lower-income groups, representing 47% of the customers.

Family Size . . . The family size likewise runs somewhat above the average—families of 4.8 are owners of clothes dryers and families of 4.0 are owners of automatic washers. The average Detroit family is composed of 3.6 persons.

Use Characteristics . . . Next findings were concerned with the use of the dryer and washer. This information was obtained through the use of recording demand and kwhr meters and is of particular importance in considering the effect of this equipment on system peak loads.

Estimated revenue from the automatic electric laundry is $34 a year. This load, although not possessing the many glamorous factors of the All-Electric Kitchen and the Sunshine Home, can equal them in promotional importance. There are but few groups of appliances that can offer the customer so many benefits, relieve the housewife from so many tasks, and still represent a desirable load.

The results of this study indicate the desirability of energetic promotion of the automatic electric laundry.



CLOTHES DRYERS used average of 3.2 days per week, tests show. Curves show average daily load per clothes dryer for: Average Monday; average daily week day including Monday; and average daily week day not including Monday. Based on data from 72 customers

Annual Kwhr Use By Family Size

Family Size	Kwhr
2 Persons	556
3 "	636
4 "	828
5 "	1,000
6 "	1,291
Over 6 (Average 8.6)	1,702

What Other Electric Equipment Do Owners Have?

	Owned By		
	Automatic Washer Customers	Clothes Dryer Customers	Saturation In Co Area
Electric Ranges	37.0%	50.9%	26.0%
Ironers	43.0	65.6	7.0
Electric Water Heaters	7.0	10.9	4.0
Clothes Dryers	12.0	100.0	0.7
Automatic Washers	100.0	82.6	.....

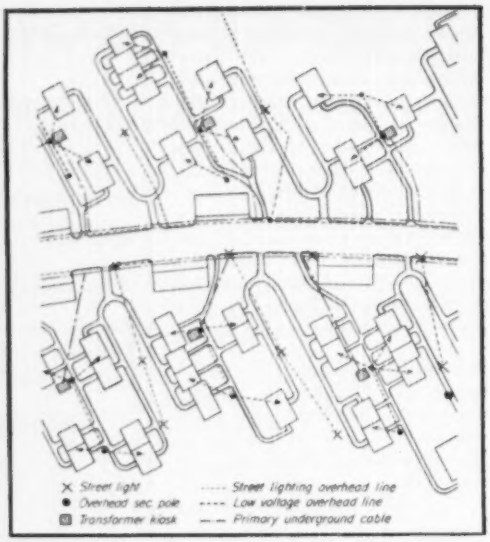
Service Calls On Clothes Dryers Detroit District

Month	No. of Service Calls	No. of Clothes Dryers In Service	Ratio, Service Calls per No. of Dryers
July 1948	239	1,039	1: 4.3
August	138	1,289	1: 9.3
September	193	1,591	1: 8.2
October	213	1,998	1: 9.4
November	191	2,435	1:12.7
December	230	2,926	1:12.7
January 1949	195	3,308	1:16.9

Average Monthly Kilowatthour Use Of Clothes Dryer Customer

Month	Kwhr
January	90
February	84
March	88
April	80
May	77
June	75
July	67
August	69
September	75
October	83
November	87
December	90

HAMADERA PARK, near Osaka City, Japan, houses Allied occupation personnel in an area of 95 acres. This residential location is served by a system of buried primary cable rings


X Street light
● Overhead sec. pole
▣ Transformer kiosk
----- Street lighting overhead line
---- Low voltage overhead line
— — Primary underground cable

TYPICAL ZONE in distribution system of Hamadera Park. Buildings in Park include 224 residences and 47 community buildings, such as a chapel, theater, school, officer's club and sewage pump houses

Buried Primary Cable Rings Serve Residential Area In Japan

Distribution system serving Allied occupation forces designed for reliability and for ease of maintenance. Transformer housings blend in with surrounding area

M. TANAKA and K. KOKONOI
Technical Laboratory, Kansai Haiden K.K., Osaka, Japan

BURIED PRIMARY CABLE rings, which serve a residential area housing Allied occupation forces near Osaka City, Japan, were designed to offer these advantages: (1) High degree of reliability; (2) ease of maintenance; (3) low cost of construction; (4) a blending with surrounding buildings and area; and (5) short construction time.

This underground-ring distribution system was installed in a 95-acre area in Hamadera Park and serves 224 residences and 47 community buildings, which include a commissary, theater, school, officer's club and sewage pump houses. Interesting electrical and construction features of the system are as follows:

Houses were divided into suitable groups of from four to eight and are supplied from a unit 30 or 50-kva, 3,300–100-v transformer installed in a ground level kiosk. Larger concentrated loads such as community buildings are served from grouped transformers. Disconnecting switches in every kiosk permit convenient testing and sectionalization.

Ring cables are buried in trenches and covered with concrete guards.

Form, size and color of transformer

Editor's Note

This description of buried primary cable rings was prompted by the article "Underground Secondary Cable Rings Serve Homes for $130 Each," by A. L. Furanna, ELECTRICAL WORLD, Dec. 17, 1949, which described an installation in Bellwood Park, London, Ontario. The authors are describing their system with reference to similarities and differences between, and conditions existing on, the two systems.

kiosks were selected to make them match as closely as possible with surrounding buildings and scenery.

Ordinary steel taped, armored lead sheath, belt type, paper insulated cable with 80 sq mm conductor was adopted for primary rings.

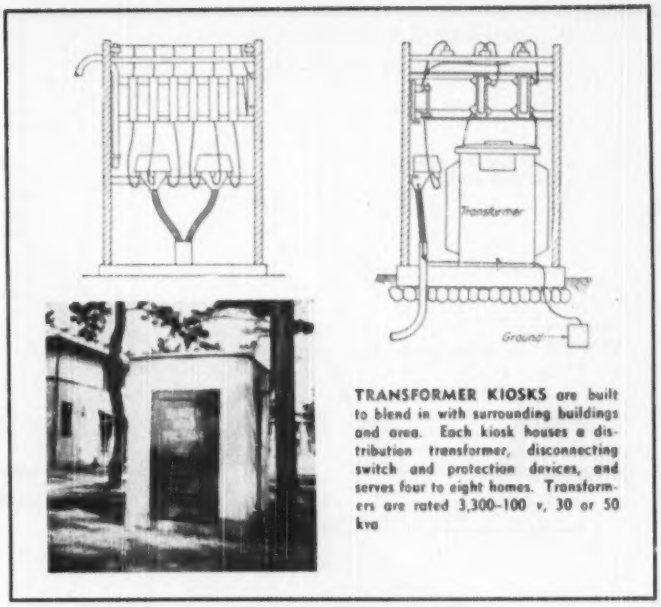
In general, secondary and services are trained up a pole located adjacent to each kiosk and run overhead to nearby houses. However, in some places it was convenient to use underground radial secondary and services. The overhead construction was selected because of the ease of installation and the low cost. Unsightliness of this overhead construction was lessened by wooden service supports which were smaller than ordinarily used. As connected load per home was quite large and only a few homes to be supplied from each kiosk, we preferred radial service drops.

Street lights are controlled with cascade operating switches which are mounted on poles.

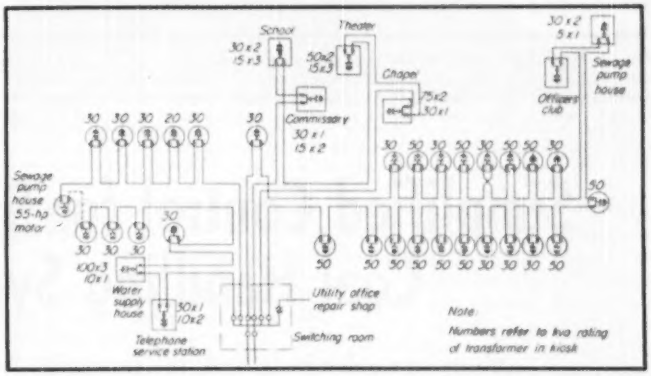
Over-all construction cost of the system, including primary feeders, main switching houses, primary rings, transformers, secondaries, services and house wiring, amounts to about $185 per house. In addition, this unit cost covers service to various community buildings. The above unit cost appears high compared with the unit cost of $130 in the Bellwood development (see EW, Dec. 17, 1949, p 90) but it may be a matter of course because power demand per house is remarkably larger in our case than it is in the Bellwood example. While a 25-kva transformer can supply loads of 18 to 20 homes in Bellwood development, a 50-kva transformer for seven to eight homes or a 30-kva transformer for four to five homes is needed in our installation.

The whole housing scheme in Hamadera was divided into three zones and construction was carried on in each zone through consecutive periods. The first zone was completed in September, 1947, and the third zone in July, 1948.

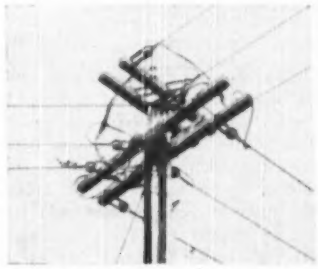
Several faults in primary ring cables were caused by careless road construction gangs during the course of installation. However, each time a fault occurred, the cable section in trouble was easily sectionalized and repaired, leaving the remainder of the system in operation. The system has proved very satisfactory to date.



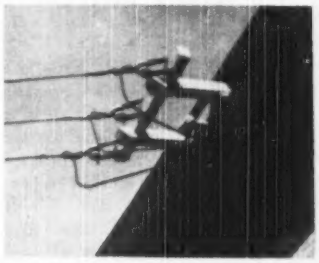
TRANSFORMER KIOSKS are built to blend in with surrounding buildings and area. Each kiosk houses a distribution transformer, disconnecting switch and protection devices, and serves four to eight homes. Transformers are rated 3,300–100 v, 30 or 50 kva



PRIMARY CIRCUIT layout for the Hamadera Park area. Primary cable is ordinary steel taped, armored lead sheath, belt type, paper insulated cable with 80 sq mm conductor. Cable in trenches is protected by concrete guards. Sectionalizing switches are in kiosks



OVERHEAD radial secondary service lines are trained through pipes from transformers housed in adjacent ground-level kiosks



SERVICE mounting on each residence follows standard design but is made smaller to lessen the unsightly overhead appearance

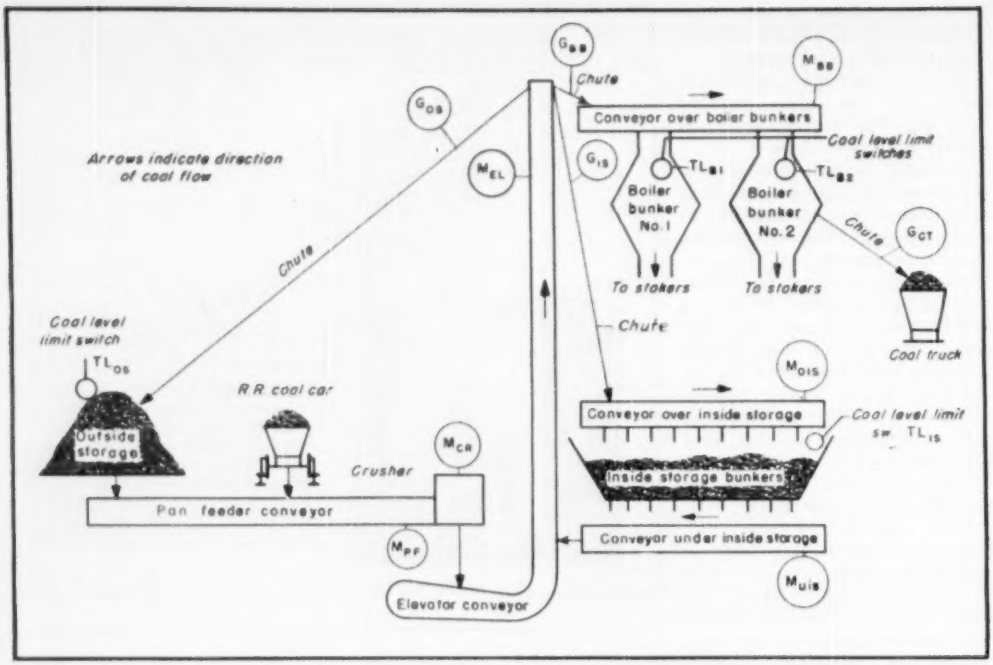


FIG 1—FUNCTIONAL DIAGRAM of coal handling system. Symbols M_{BB}, M_{EL}, M_{OIS}, M_{CR}, M_{PF} represent motors for boiler bunker conveyor, elevator, conveyors over and under inside storage bunkers, crusher, and pan feeder conveyor, respectively. Similarly G_{BB}, G_{OS}, G_{IS}, G_{CT} are motors for gates in coal chutes. TL_{B1}, TL_{B2}, TL_{IS}, TL_{OS} are coal level limit switches in boiler bunkers 1 & 2, inside storage bunkers, and on outside storage pile. There are six control relays with normally open holding contacts for the entire operation

Simplified Control for Steam Plant Coal Handling System

Six relays selectively and automatically handle coal from cars to boiler bunkers and to locations between these points

FRANK E. REEVES, Power Plant Design Engineer, Bainard and Burk

ONLY SIX CONTROL relays are required for selective automatic operation of coal handling in a new steam plant for central Alaska. The system is applicable to other locations where coal is stocked in covered, heated bunkers, and also is stored in outside piles. Selection and starting of five conditions of coal flow is by momentary push buttons.

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After thawing out the arriving cars by large oil burners, coal is dumped upon a pan feeder which conveys it to a crusher. In 0.75-in. lumps, it is then dumped upon a horizontal section of an elevator conveyor. From the elevator conveyor coal may be fed by chutes: (1) To a conveyor over the boiler bunkers; (2) to a conveyor over inside heated storage bunkers; (3) to an outside storage pile. Choice of destination is determined by the position of motor-operated gates in the chutes. A conveyor under the inside storage bunkers permits delivery to the elevator conveyor without going through the crusher. Coal from the outside storage pile is pushed through a hopper feeding the pan feeder conveyor from which it is again delivered through the crusher to the elevator conveyor.

The accomplishment of the entire sequence of operations by six control relays is done by utilizing normally-open holding contacts, standard in

motor starters, as interlocking contacts. One such relay is used for setting up the necessary circuits for the specified condition. An extra relay (R6, Fig 3) is necessary if all starters are to be standard with one normally-open and one normally-closed auxiliary contact. Otherwise an extra normally-open contact would have been needed in connection with the elevator conveyor motor starter.

Full interlocks prevent improper operation. These provide for gate openings and motor starting automatically in correct sequence. One push button starts automatic operation for each condition. Shutdown of each condition is effected either automatically by coal level limit switches or manual push button. On shutdown by either method, gates close automatically and the equipment is ready at once for the operation of a different condition. When the start push button for a selected condition is actuated, the coil of the particular condition relay will be energized if all equipment is in readiness; otherwise the coil cannot be energized. The condition's green pilot light goes out and a red pilot light shows that the relay coil is alive. The relay coil is locked in through its own contact, and the condition relay remains alive as long as that selected condition is in operation. As gates open and motors start in sequence their indicating lights change from green to red so that the sequence may be observed from the control panel. If any equipment unit fails to function, these pilot lights indicate the location of the trouble and facilitate maintenance.

Time-delay relays are of short duration but prevent the simultaneous starting of any two larger motors. Motors then start automatically.

The automatic control permits choice of any one of five conditions by a selector switch and momentary push buttons. Operating sequences follow for the designated five conditions of service. All operations but the last (No. 5) must be run separately; but No. 5 (feeding coal from boiler bunker No. 2 to coal trucks for domestic consumption) may be run simultaneously with any one of the other selected conditions. To this end a four-position selector switch is employed in lieu of mechanically interlocked push buttons to prevent simultaneous operation of any two of the first four conditions.

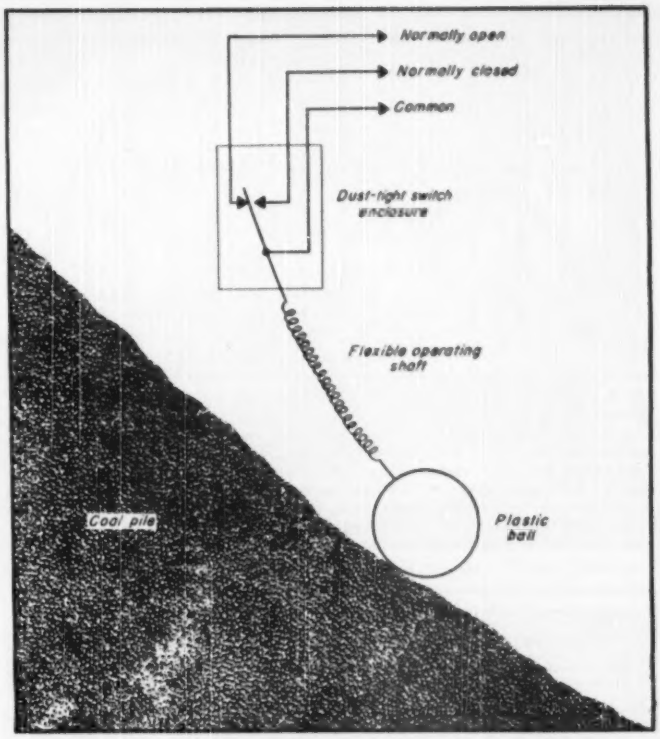


FIG 2—COAL LEVEL limit switch in bunker, schematic diagram. Rise of slope of coal pile actuates switch. Flexible operating rod provides overtravel, to prevent damage to switch if coal continues to flow after the switch operates. The coal is removed by a bulldozer

Condition 1. Feeding coal from cars or outside storage pile to the boiler bunkers.

Condition selector is set on "1" and the two-position selector switch set for the boiler bunker desired. If the manually operated gates for that bunker are open when the start push button is pressed, the condition relay R_1 coil will be energized and locked up through its own R_1 normally open circuit. The sequence then progresses automatically.

Another normally-open contact of R_1 provides an L_2 feed to the "opening" contactor G_{BBO} for the motor-operated gate in the chute feeding coal from the elevator head to the boiler bunker conveyor. When this gate is fully open, its limit switch transfers and provides a feed through a normally-closed contact of R_4 to motor starter M_{BB} to start the boiler bunker conveyor. The holding contact of M_{BB} is used to energize the coil of time-delay relay TD_{EL} which prevents the elevator motor from starting until the expiration of the delay period when contacts TD_{EL} close, energizing the coil M_{EL} of the starter controlling the elevator conveyor motor. Time-delay relay coil TD_{CR} is then energized through a fourth contact of R_1 and the holding contact M_{EL} of the elevator motor starter. At the end of the second time-delay period the coil of motor starter M_{CR} for the crusher is energized. Similarly, after one time-delay, the pan feeder conveyor starts.

The selected Condition 1 is now in full operation, and a complete row of red pilot lights shows, except for the lights controlled by a coal level limit switch in the boiler bunker. These will still show green. When the bunker is full, the coal level limit switch transfers its contacts, causing

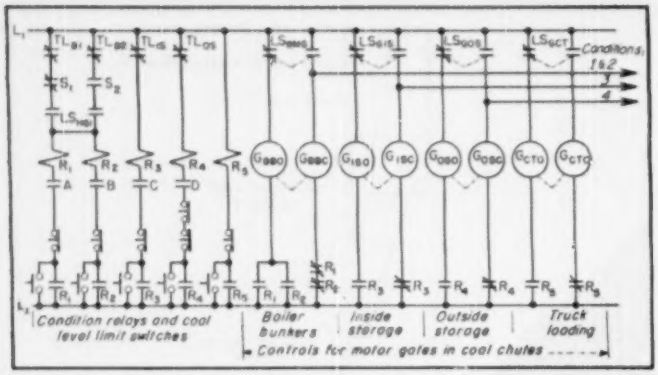


FIG 3—ELEMENTARY DIAGRAM of control relays and reversing contactors for motor-operated chute gates. Symbols R_1, R_2, R_3, R_4, R_5 represent control relays for conditions 1 to 5; S_1, S_2 contacts on boiler bunker coal level limit switch selector and A, B, C, D contacts on conditions selector switch. Similarly TL_{B1}, TL_{B2}, TL_{IS}, TL_{OS} are coal level switches bunkers 1 & 2, inside and outside storage. LS_{B1G}, LS_{B2G}, LS_{ISG}, LS_{OSG}, LS_{TCT} are limit switches in motor-operated chute gates feeding boiler bunker conveyor, conveyor over inside storage, outside storage, and coal truck loading station. G_{B1BC}, G_{B2BC}, G_{ISBC}, G_{ISSC}, G_{OSBC}, G_{OSSC}, G_{CTC}, G_{CTC} are motor-reversing contractors for opening and closing gates in chutes to boiler bunker conveyor, inside storage conveyor, outside storage and coal truck loading station.

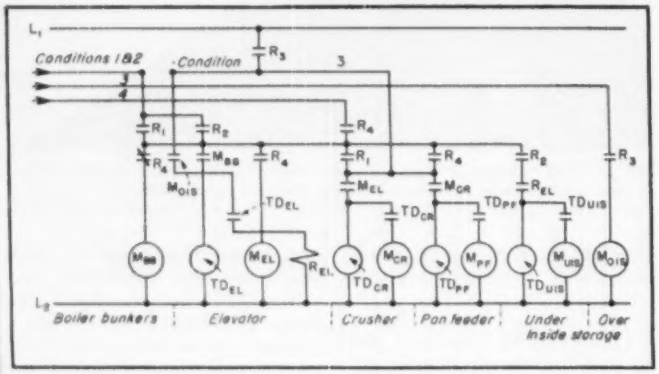


FIG 4—ELEMENTARY DIAGRAM of motor control scheme for coal conveyors and crusher

Condition 1	Condition 2	Condition 3	Condition 4
Boil. Bunk. Conv. (M_{BB}) Elevator (M_{EL}) Crusher (M_{CR}) Pan Feeder (M_{PF})	Boil. Bunk. Conv. (M_{BB}) Elevator (M_{EL}) Conv. under Inside Stor. (M_{UIS})	Conv. over Inside Stor. (M_{OIS}) Elevator (M_{EL}) Crusher (M_{CR}) Pan Feeder (M_{PF})	Elevator (M_{EL}) Crusher (M_{CR}) Pan Feeder (M_{PF})

Motors start automatically in opposite sequence to direction of flow of coal. Starting of each motor initiates delay period to prevent simultaneous starting. All motor starters are equipped with 1 N. O. and 1 N. C. auxiliary contact. N. O. contacts used for interlocking to provide for sequence starting. N. C contacts used for green pilot lights (not shown).

the red light to show also killing the feed to the relay R_1 coil and shutting down all motors for Condition 1. A normally-closed contact of R_1 will close, energizing contactor G_{BBC} on the boiler bunker chute gate. When the gate is fully closed, all lights for the condition will show green except that fed by the coal level limit switch, which remains red until the coal level drops through usage. Condition 1 may be stopped at any time at the condition stop button. In event of dropout of any motor starter, all coal feed to that point will be stopped.

Condition 2. Feeding boiler bunkers with coal from outside heated storage bunkers.

This condition operates similarly to Condition 1, except that the pan feeder and crusher do not start. Instead, the conveyor under the inside bunkers starts to deliver coal to the elevator conveyor. Condition 2 relay is locked up by Condition 2 start push button.

Condition 3. Feeding inside storage bunkers with coal from cars or from outside storage.

When Condition 3 start push button is pressed, Condition 3 relay locks up and the sequence starts with the automatic opening of the gate in the chute from the elevator head to the conveyor over the inside storage bunkers. When this gate is fully open, motor starter M_{OIS} controlling the conveyor over the storage bunkers is energized instantly, and the elevator conveyor, crusher and pan feeder start after time delays. This condition is shut down automatically by the limit switch in the bunker which transfers its contacts when the bunkers are full.

Condition 4. Feeding outside storage pile from cars.

Condition 4 push button is pressed, locking up Condition 4 relay R_4. The gate in the chute feeding the outside storage pile then opens automatically and the elevator conveyor is started instantly when the gate limit switch transfers. A limit switch under the end of the chute provides automatic shutdown of this condition to prevent choking the chute by piling up coal below. Coal is removed by a bulldozer. The bulldozer operator can stop this Condition by pressing push button PB_{40}, which is located near the bottom end of the chute, but he cannot restart the Condition from outside.

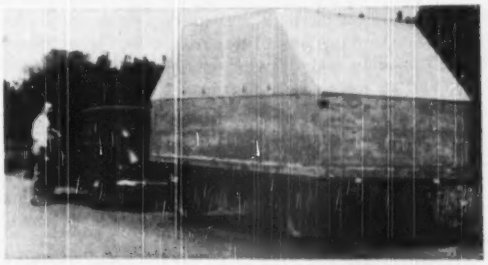
Condition 5. Filling coal trucks for domestic use.

Truck driver has full control, involving only a motor-operated gate in the chute from boiler bunker No. 2 to the truck loading station.

MUSIC ON THE MARCH is provided by inside PA system. After the parade float can be closed up and hauled to next community celebration

Versatile Float Solves Small City Parade Problem

HERBERT JONAS, Yakima, Wash.



DISPLAY MATERIAL that is scheduled for district offices can be carried conveniently in the hollow interior of the parade float

UTILITIES SERVING smaller cities have both an opportunity and a problem in the traditional annual community-day celebration. The occasion almost always calls for a street parade with floats sponsored by the city's principal business firms.

So far as the utility is concerned, the parade float is a must. And therein lies the opportunity to tell an effective rate and service story.

But the problem, particularly in smaller communities, is that of tying up a line truck or other vehicle while employees, who could more effectively be doing something else, spend two or three days shaping and decorating a parade entry. The total man-hour cost of each hometown parade entry is difficult to arrive at, but the cost of materials alone, as shown by requisitions and petty cash receipts, is known to amount to as much as $50 for an occasion.

Twenty-two Washington and Oregon towns served by Pacific Power & Light Co have scheduled annual celebrations. Each had called for a brand new parade entry every year. That meant 22 floats for 22 one-day stands. Howard Whelpley, advertising specialist, saw an opportunity to save money and do a better job. He recommended a single, durable float built on a light, four-wheel trailer.

The parade entry could be hauled from town to town by hooking the trailer to his car, and Whelpley could still haul around required display materials in the hollow interior of the float.

Built from plywood and wallboard in modernistic design at a cost of about $100 for materials, the trailer float is arranged with cut-outs that can plug "Dayton Days" one day and the "Wapato Harvest Festival" a week later. The copy theme is flexible and inexpensively amended for each new occasion.

Because some smaller cities lack sufficient music to spark a full-length parade, the trailer was wired for sound during its second year of operation. This sound-effects feature added to the popularity of the float and increased requests for participation in community events.

An estimated 150,000 persons, assembled in smaller city parade audiences ranging from 3,000 to 15,000 persons, viewed the Pacific float in a single season.

Low Cost AC Load Flow Board Represents Impedance with Resistors

Cost of board is about one-tenth of comparable conventional analyzer. Compactness and ease of operation are added features for small utility

W. E. ENNS, Asst Chief Engineer, Portland General Electric Co, Portland, Ore.

SYSTEM LOAD FLOW and voltage problems are being solved by Portland General Electric Co on a relatively inexpensive new type ac network analyzer using only resistance circuits. Operation of the analyzer is based on the principle that an impedance circuit can be accurately represented by two sets of two resistors, providing that voltage components and an associated measuring instrument are properly applied.

Setting up these voltage components at the buses eliminates need for generators and loads because flow in each circuit is entirely dependent on its constants and the voltages at its terminal buses. Algebraic summation of real power flow in all of the circuits connected to any bus is then equal to the power load or generation at that bus. The same is true for reactive power.

Operation of the Board . . . In operation, the board is set up for a desired study by plugging into each circuit the four proper resistors representing the M and N constants (see example) for that circuit. In-phase and quadrature voltages are individually adjusted to give the required values of real and reactive power load or generation at all buses. When the board is thus balanced the operator reads and records, in turn, the real and reactive power flow for all circuits connected to each bus. Bus voltage components are also recorded, giving a complete record of voltage and load flow for the study. Bus voltage components can be quickly converted to total voltage and phase angle by use of a slide rule.

A single wattmeter with a double throw switch to change the potential circuit from the watt to the var connection is used for these readings. Thus both reactive power flow and real power flow are measured with the same setup. Another double throw switch on the control panel indicates, with respect to the bus, flow "IN" in one position, flow "OUT" in other.

NO GENERATOR or load units are used in this versatile and relatively inexpensive ac network analyzer built by Portland General Electric for system load flow and voltage studies. Impedance circuits are represented by two sets of resistors (located above the meters and below the desk) connected to in-phase and quadrature voltages through plugging panels in the panel on the left. Below the meters on the two panels in front of the operator is the bus voltage plugging section which supplies these voltages from a variable autotransformer. The whole board, which provides 92 circuits, 50 four-circuit buses, and 10 eight-circuit buses, is only 66 in. long, 82 in. high and 18 in. deep

60 Buses, 92 Circuits . . . The analyzer, as built, can make load flow and voltage studies of any transmission or distribution system not exceeding its present capacity of 60 buses and 92 circuits. Of the 60 buses, 50 are 4 circuit and 10 are 8 circuit. Two or more of these buses can be set up to represent a single bus with more than 8 connections.

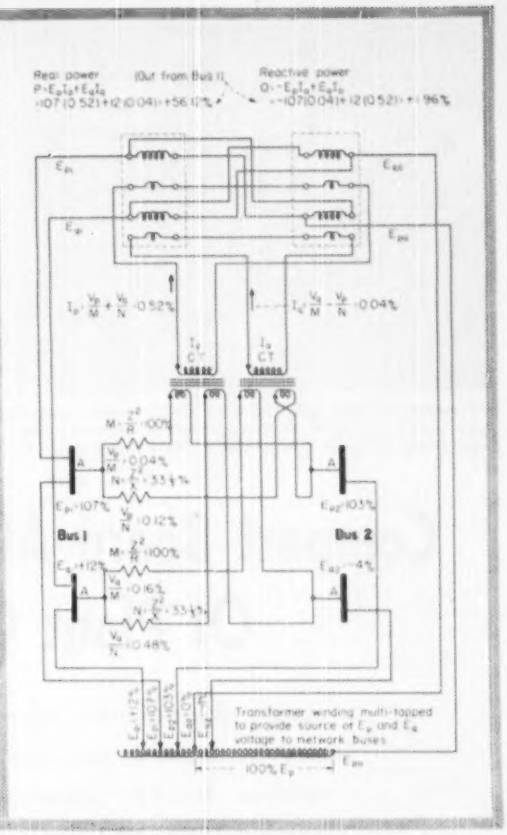
The only limitation on the number of generators or loads is that the combined total of the two cannot exceed the number of buses available, nominally 60. This is possible because no generator or load units are used and adjustment for bus input or load is accomplished simply by adjusting the two voltage components to each bus.

Separate autotransformers can be provided to correct for buck or boost due to differences in transformer ratios in the loop circuits of a network. This analyzer accurately simulates this condition instead by the use of an extra bus and application of the required buck or boost ahead of the M and N constants of the transformer. This necessitates reading the transformer circuit separately and adding it to the bus reading for total bus loading.

Studies set up on the analyzer thus far have used between 30 and 40 of the 60 buses and between 50 and 60 of the 92 circuits available. In common with studies on conventional analyzers, most of the time is required to prepare the load and network circuit data before the problem can be set up on the board. Once the plugging diagram and other data are prepared, it takes only a few hours to do the necessary plugging to get the problem set up.

Procedure, Time Required . . . When the proper circuit constants M and N have been plugged on the proper buses, the entire procedure in balancing the board consists of adjusting the two voltage components at each bus. The analyzer is designed so

Bus 1 Z=R+jX =(10+j30)% Bus 2
E1=Ep1+jEq1 =(107+j12)%
A
Σ=Ip+jIq
A
E2=Ep2+jEq2 =(103−j4)%
Vp1,2 =107−103=+4%
Vp2,1 =−4%
Vq1,2 =12−(−4)=+16%
Vq2,1 =+16%
Computation of real and reactive power with constants used on the analyzer:
M = Z/R = (10² + 30²)/10 = 100%
N = Z/X = (10² + 30²)/30 = 33⅓%
*Ip1 = Ip1/M + Ep1/N = 4/100 + 16/33⅓ = 0.04 + 0.48 = 0.52%
Iq1 = Iq1/M − Eq1/N = 16/100 − 4/33⅓ = 0.16 − 0.12 = 0.04%
P1 = Ep1 Ip1 + Eq1 Iq1 = 107 (0.52) + 12 (0.04) = + 56.12% (Out from Bus 1)
Q1 = − Ep1 Iq1 + Eq1 Ip1 = − 107 (0.04) + 12 (0.52) = + 1.96% (Out from 1)
Ip2 = Ip2/M − Ep2/N = −4/100 + 16/33⅓ = −0.04 + 0.48 = +0.52%
Iq2 = Iq2/M − Eq2/N = −16/100 − −4/33⅓ = −0.16 + 0.12 = −0.04%
P2 = Ep2 Ip2 + Eq2 Iq2 = 103 (−0.52) + (−4) (−0.04) = −53.4% (Into Bus 2)
Q2 = − Ep2 Iq2 + Eq2 Ip2 = − 103 (−0.04) + (−4) (−0.52) = −6.2% (Out from Bus 2)
Power Loss = 56.12 − 53.4 = 2.72%
Reactive Loss = 1.96 + 6.2 = 8.16%
*Derivation of relations:
Ip = Ep/M + Eq/N and Iq = Eq/M − Ep/N
IZ = Ip + jIq where Z = R + jX
I = Ip + jIq = Ep2 + jEq2 / R + jX = (Ep2 + jEq2)(R − jX) / (R + jX)(R − jX)
= Ep2R + Eq2X + j(Eq2R − Ep2X) / R² + X² (= Z²)
= Ep2R/Z² + Eq2X/Z² + j(Eq2R/Z² − Ep2X/Z²)
Let M = Z²/R N = Z²/X
I = Ep2/N + Eq2/M + j(Eq2/M − Ep2/N) = Ip − jIq
Therefore
Ip = Ep2/N + Eq2/M and Iq = Eq2/M − Ep2/N



MATHEMATICAL APPROACH upon which analyzer is based breaks complex quantities into real and reactive components. Constants M and N are developed and treated as circuit constants, to be plugged into board. Fundamental principle of the analyzer was first published by the author in December, 1943, AIEE Transactions as "A Simple Calculator of Load Flow in A-C Networks"

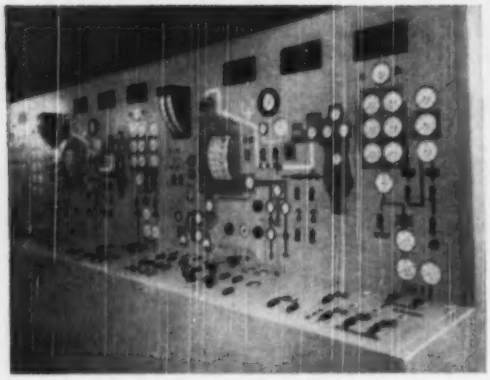
TWO-ELEMENT, THREE-PHASE WATTMETERS connected as shown in this diagram will read separately real and reactive power flow in impedance circuits. Actually a single wattmeter is used and a double-throw switch changes potential circuits from the watt to the var connection. A double-throw switch indicates flow "in" or "out" with respect to bus. Data is for example shown above

all of the operating controls required for balancing are located in the desk top and in two panels located immediately in front of the operator.

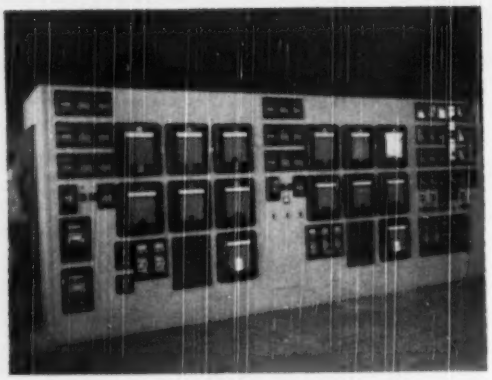
If the new study is a modification of a previous study already set up, the time required to change the board plugging may be a matter of only a few minutes. If the new problem uses most of the network which was previously set up and the load conditions approximate those of any previous condition, the bus voltages are plugged in the same as determined for that previous condition and the board may be balanced quickly. Three such studies have been made in one day with complete readings recorded on each of the three study diagrams.

If the new study is radically different from any previous study the balancing and recording may take one operator from one to three days. Cumulative experience and availability of more past studies as time goes on will no doubt reduce the time required for most studies undertaken.

Adaptable for Short Circuit Studies . . . Design of the board, which was developed and patented by the author and built by the Portland General Electric Co, can be modified to provide an analyzer suitable for both load flow and short circuit studies. Since the company already had a dc calculating board for making short circuit studies, this particular ac board was not built to set up and solve them. If, however, the company's 60-bus and 92-circuit load flow board had been built for making short circuit studies it would have provided 240 buses and 368 circuits for this purpose. As already explained each load flow circuit requires four resistance units whereas only one resistance unit is required for each circuit of the sequence networks for short circuit studies. A relatively small and inexpensive analyzer of this type should prove an important tool for engineers of utilities not now having access to network analyzers.



MECHANICAL AND ELECTRICAL BOARD in mimic representation (colors are used in actual design) for full routine and emergency control in Morgan Creek Station of Texas Electric Service Co



RELAYS, RECORDING INSTRUMENTS, watt-hour meters and other accessories are placed on back of board for compactness, with critical indications carried to front by alarm or annunciator

Compact Board Affords Full Control Of Plant Operations

Mimic diagrammatic representation employs miniature mechanical instruments and pneumatic transmission. Readily interpretable indications minimize communication and give intelligent control at all times

P. E. GOURDON and **H. L. LOWE**
Chief Mechanical Engineer — Chief Electrical Engineer
Ebasco Services, Inc, New York

AN EXTREMELY COMPACT generating station control board has been developed. Centralization of control is carried out to the extent that all operations necessary for adjustments accompanying load changes (that is, normal running controls) for one generating unit, and all operations necessary for quick action in case of emergency, are practically within arm's reach of an operator. This applies to complete facilities from fuel preparation to the electric output of the generator. Correspondingly, all the essential indications of positioning of local control equipment, and indications of pressures, flows, combustion conditions, drum level, electrical conditions, that is, the essentials of proper functioning of main and auxiliary equipment, are within close view of one operator.

Mr. J. B. Thomas of Texas Electric Service Co, one of the first to recognize the substantial advantages of centralized control, instigated Ebasco Services Inc to undertake and carry through this development for his company.

Arrangement of controls and instruments as to location on the board follows sequentially the arrangement of major equipment in the power production process from fuel to generator output; also principal runs of piping and buses and items of major equipment are shown in mimic (distinctive colors being used in the actual design) to facilitate interpretation of the indications, and to assist in obtaining speed and accuracy in manipulation of controls.

This diagrammatic representation also should assist in the training of operators and should be of value in connection with shifting of operators from one plant to another. The full length of the board is only eight feet, and notwithstanding the degree of compactness that this implies, space is provided for the maximum number of instruments and controls, need for which reasonably may be anticipated in modern steam station design for units up to 75,000 kw and perhaps even larger. For example, provision is made for use and control of oil, gas, and coal—and control of the coal preparation system.

Advantages . . . Of considerable advantage is the possibility afforded for saving in operating personnel. Except for the operation of starting up cold, the unit can be controlled completely from the control board, and by one man if necessary. In starting up cold, the opening and closing of drains, and some other local manual operations are necessary, but these are not necessarily simultaneous, and in general can be handled by one man who at other times would handle various routine plant duties. Thus, as an extreme example of the possibilities afforded, a crew of two men could completely control a boiler-turbine generator unit.

Another very important advantage is the very close coordination that can be maintained between various related operations at different locations in the station. No time need be wasted in communication between operating personnel at different locations, hence communication errors are eliminated. Related operations involving both steam and electric equipment can be coordinated directly and carried out rapidly in the desired sequence. This is of great importance during an emergency.

This design avoids piping into the control room of water, combustible gas and steam. Also, it eliminates use of mercury in instruments. Both features represent marked improvements over previous boiler and turbine instrumentation practices.

Another advantage is the saving in size of operating room and in its lighting, ventilation, and air conditioning. There are other incidental advantages some of which have been realized while others are indicative of promise. It is planned to explore the possibilities of modified operating procedures that may be afforded through use of the new control board design.

Compactness Achieved . . . Compactness was achieved in two ways:

1. By locating all recording instruments, watthour meters, and relays at the back of the board, reserving all front space for indicating instruments, signal devices and controls. This feature was adopted only after many discussions with plant operators to check its soundness from a practical operating standpoint. By use of bell alarms and annunciators it was unnecessary to use so many indicating instruments on the front panel as would otherwise be required. Similarly this also permits recording instruments to be put on the back of the board.

2. By carefully selecting all front panel instruments and devices to secure minimum size consistent with required readability or ease of manipulation. Instruments particularly for the mechanical side of the board, are of miniature proportions in comparison with conventional instruments commonly used in decentralized control arrangements. This was accomplished by use of the principle of re-transmission of indications, with low-pressure compressed air as a medium, controlled by transmitters integral with the ordinary full-sized instruments at the points of instrument connection in the plant. With this arrangement the maximum pressure encountered at the control board is 15 psig with only two exceptions for control air pressures, one of these involving 28 psi and the second case 80 psi.

Economic Gains . . . The cost of control boards of the new design is higher than that of conventional boards but this is offset by the savings in size of operating room, reduction in piping, lighting, ventilation, air conditioning, not to mention possible large savings in operating costs by reduction of operating personnel. While the design as a whole is new, the component parts are not new or untried, and completion of the development was met with immediate widespread acceptance for inclusion in generating station plans. Control boards of the new type are now on order for factory fabrication for 13 new generating units of eight operating companies. This has made possible a degree of standardization which usually is not possible to achieve initially in a new design. For the 11 units mentioned, the only differences among them are the numbers of fans per boiler, numbers of pumps, and differences in systems of combustion control. The elimination of one or more devices from a particular board is taken care of by leaving corresponding spaces blank.

Other Features . . . Indicating instruments for generator, exciter and buses are somewhat larger than the instruments on the mechanical side of the board because the smaller ones now available are not suitably rugged and dependable for power plant application. However, the standard instruments have been modified so that their cover glasses are deep-dished to protrude through the panel and the internals are set forward to make the dials flush with the panels. Scales are on raised rings level with the pointers for elimination of parallax.

Instruments for indicating boiler feed, steam flow, drum level, furnace draft, and gas flow are standard vertical bellows-operated draft gages. All except furnace draft are actuated by the compressed air re-transmission system previously mentioned. Two completely separate drum level indicating systems are provided for safety.

Pressure gages are of the Bourdon tube type actuated by the re-transmission system.

The gages for combustion control (except furnace draft mentioned above) are airplane speed indicators with special dials, and of course without the altitude compensating feature, normally supplied.

Remote manual control devices for use with combustion control and fuel control systems are identical to those customarily used except for special switch handles and in some cases direct panel mounting instead of subpanel mounting.

A new style of switch handle midway between finger and pistol grip types was designed to point clearly to position index. This also eliminates protrusion far enough above the bench to obstruct nameplates or to be thrown inadvertently by an operator while he is reaching for another switch.

To represent valve positions rectangular signal lamps are mounted on the mimic piping, one parallel to, and one at right angles to the piping so that both color and position will indicate whether a piece of equipment is in use or not. This feature was the result of a survey which showed that there is some confusion regarding meaning of color, as between mechanical and electrical sections of plants. In the design as adopted, green lights at right angles to the piping indicate equipment out of service, while red lights parallel to the piping indicate equipment in use.

Economical System Ground Impedances And How To Get Them

Relative effects of earth's resistivity and resistance of earth contact form basis of formulas confirmed by results of many tests. Curves aid use of formulas

FRED VON VOIGTLANDER, Commonwealth Services, Inc

EFFECTS of earth resistivity on power system operation are reflected largely in the problems presented in securing adequately low earth contact resistances on the system, in the zero sequence impedances of lines and cables, and in residual coupling of power lines to other wire and cable lines. Earth resistivity becomes a cause for concern when it is appreciably higher than 100 meter ohms and then because of the difficulty in obtaining satisfactory earth contacts. A range in earth resistivity of from 10 to 1,100 meter ohms will produce a change in zero sequence impedance of a typical power line without overhead ground wires of about 50% so that this factor alone is usually not of great concern.

In inductive coordination of low frequency residuals, however, a range in earth resistivity of from 10 to 1,000 meter ohms will produce considerable increase in coupling between the lines involved, ranging from double at close separations to fifty times or more at separations in the order of 5,000 ft.

Electrical resistivity of the earth enters into the impedances of circuit elements through two factors: (1) Earth contact resistance, such as the resistance obtained with a ground rod driven into the earth; and (2) influence of earth resistivity on self and mutual resistances and inductances of grounded conductors.

Results Based on Tests . . . From the work by John R. Carson of the Bell Telephone Laboratories, confirmed by the results of many tests, the equivalent resistance of the earth return path at 60 cycles has been determined as 0.095 ohms per mi for a range of earth resistivity from 10 to 10,000 meter ohms. This surprisingly low resistance of the earth path makes it apparent that insofar as conductivity is concerned, the resistance of the earth *contact* is very important.

Earth contacts are used primarily to hold the potentials of the connected components of an electric power system to a relative level with respect to zero potential. This usually is done to keep the non-current carrying metal components of equipments and installations as close to zero potential as possible for safety to personnel.

Signaling systems frequently are grounded to utilize the earth as a conductor and to protect lines and apparatus against abnormal voltages.

Tests and calculations supported by many years of operating experience have shown conclusively the importance of low resistance grounds for all protective purposes. The reason for this is quite simple. The potential of the grounded power system component must rise to a potential above true ground equal to the product of the current flowing through it and the impedance of the earth contact. This is true whether the current involved is a few milliamperes of direct current for signaling, or whether it is a 100,000-amp lightning discharge.

Factors in Design . . . The more significant factors in the design of an earth contact are (1) Maximum resistance allowable, (2) current-carrying capacity required, and (3) the resistivity of the earth in the locality.

Earth contacts may be placed in three classifications; (1) Grounds on customer's premises for service connections, (2) grounds along power lines for the overhead ground

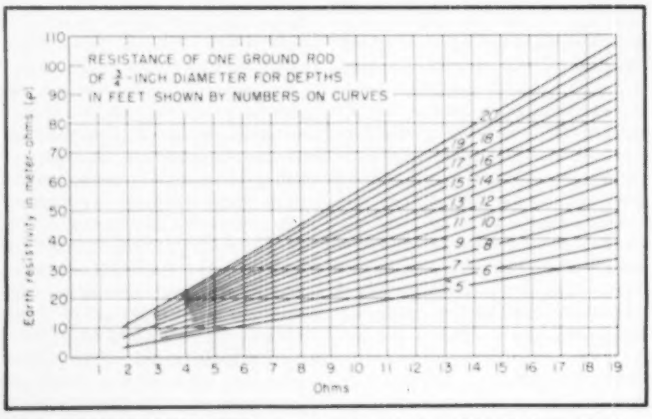


FIG 1—GROUND RESISTANCES vary with earth resistivity and length of ground rod

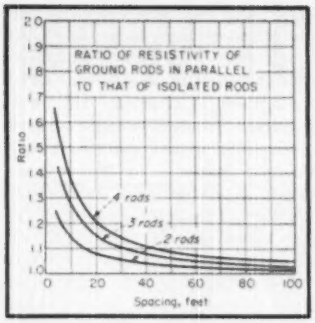


FIG 2—RESISTANCE of ground rods arranged in parallel does not vary in direct proportion to number of rods

wire and the neutral conductor, and (3) station grounds. Maximum desirable resistance for service connection grounds under the National Electrical Code is 25 ohms. Typical resistances for power line grounds are from 10 to 25 ohms. The resistance for major station grounds should be in the neighborhood of one ohm.

Grounding both communication and power supply facilities on the customers' premises to a common, low-resistance ground prevents dangerous differences in potentials existing between electrical devices that may come into contact with personnel, because of lightning, faults, or accidents. Also interconnection of primary and secondary distribution neutrals and lightning arrester grounds to obtain the advantages of all available grounds in parallel and to keep the potential differences to ground on the system to a minimum is now accepted practice.

Power line pole and tower footing grounds are generally required for grounding the overhead ground wire and the neutral line conductors. A ground resistance of 10 ohms is widely accepted as a desirable value for such grounds and it is usually obtained by rods driven near the base of the pole or tower footing. Normal current from the ground wire is ordinarily zero and lightning currents are of such short duration that the heating and drying out of the earth contact by them is of no significance. Normal unbalances of distribution systems should be well within the thermal limits of the rods so that the chief concern is one of securing sufficiently low resistance.

Power plant and substation grounds are of great importance because of the large investment in equipment and apparatus and because of the necessity of protecting personnel. Low-resistance grounds are essential to the proper functioning of protective apparatus. Station grounds should be made as low as feasible; one ohm usually is considered the maximum to be desirable. If excavation is necessary in the construction of the station, the grounds should be placed below the base slab. The earth contact may be made by deep-driven rods, coils of wire or plates, by a grid made up of conductors welded together or by a counterpoise consisting of a network of lateral or radial conductors.

Design of Earth Contacts . . . Given the resistance and current-carrying capacity required, the designer of an earth contact needs to know the earth resistivity for the location involved. Earth resistivity should be determined on the basis of year-round performance since moisture and frost conditions will affect all but deep-driven rods. Tests of the exploratory grounds need to be made periodically until the trend has been established.

The most economical type of artificial ground in undisturbed earth is the driven ground rod. The conductivity varies as the logarithm of the radius and as the length and for this reason the diameter is determined largely by mechanical requirements. Figures 1, 2 and 3 show how these factors vary; they have been derived from Dwight (2).

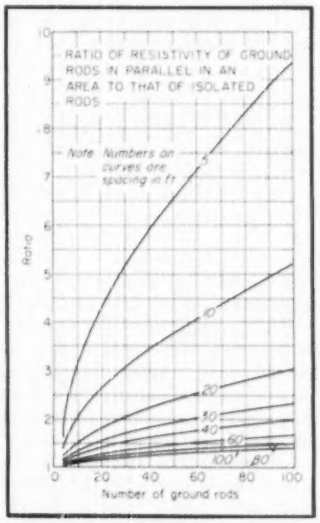

RATIO OF RESISTIVITY OF GROUND RODS IN PARALLEL IN AN AREA TO THAT OF ISOLATED RODS
Note: Numbers on curves are spacing in ft
Ratio
Number of ground rods

FIG 3—RATIO of ground rods in parallel in an area to isolated rods shows decreasing benefits as number of rods increases

Figure 1 presents the relationship between earth resistivity and resistance of one ground rod ¾ in. in diam for the lengths 5 to 20 ft. The curves are plotted for the lengths of rods indicated by the numbers above the curves.

Figure 2 shows the relationship between the ratio of resistance of ground rods in parallel to the resistance of isolated rods and the spacing between the rods. The curves are plotted for two, three and four rods as indicated. The three rods are located on the apexes of an equilateral triangle and the four rods on the corners of a square.

Figure 3 shows the relationship between the ratio of resistance of ground rods in parallel to the resistance of isolated rods and the number of rods. The curves are plotted for 5 to 100-ft spacings as indicated. The arrangement of the rods for these curves is that of a square bounded by the outer rods. The ratios also apply quite well to rectangular areas, but do not apply to part of a group of rods or to a group in close proximity to another group. The rods must be part of the same group and all the rods in the area must be considered in that group.

These curves make it evident that there is an optimum number of rods for maximum effectiveness in a given area and that the spacing between rods in parallel must be on the order of two to four or more times their length to make rods in parallel worthwhile. It is also evident that single deep-driven rods are much more effective than a group of short rods of the same total length. Furthermore, deep rods are considerably less susceptible to seasonal changes. Finally, there is a definite limit to the reduction in the earth contact resistance that can be effected by driving parallel ground rods into an area.

In sections of the country where the nature of the subsoil prevents the installation of deep-driven ground rods, it often becomes a serious problem to secure adequate earth contact

resistance. A counterpoise consisting of a network of conductors buried to a depth of about two feet becomes especially effective for obtaining usable earth contacts. The effectiveness of the counterpoise depends primarily upon placing sufficient wire in the ground to attain the required conductance. If the moisture contact of the sub-surface soil is low the counterpoise should be very extensive. It may require thousands of feet of wire laid out in a network of inter-connected groups of radial and/or lateral conductors.

Since the equations for counterpoise problems are more complicated than those for the driven rods and since they have not been reduced to a set of convenient curves, counterpoise computations are more difficult and time consuming. Dwight (2) gives equations which are very useful and the details of the design can be calculated in a straightforward manner provided that the resistivity of the soil is known.

Influence of Earth Resistivity . . . As outlined in the preceding discussion, and as would be expected, the resistances of earth contacts are direct functions of earth resistivity. Equally significant but less obvious is the influence of earth resistivity on the resistance and inductance of alternating current circuits having an earth return. Relay and protection engineers, both of power supply and communication organizations, are greatly interested in these impedances. The influence of earth resistivity on the zero phase sequence impedance of lines and cables is of particular interest especially on transmission lines that are equipped with overhead ground wires.

The Joint Subcommittee on Development and Research of the Edison Electric Institute and of the Bell Telephone System has developed the equations for the impedances of lines. In addition they have provided a number of curves facilitating their use. These impedances have been set up in terms of the self-impedance of one phase wire and the mutual impedance between one phase wire and an adjacent phase wire based on the equivalent spacing of the line. The overhead ground wire is taken into account similarly in terms of its self-impedance and the mutual impedance between it and one phase wire based on the equivalent spacing between the ground wire and the three phase wires of the line. The overhead ground wire is taken into account similarly in terms of its self-impedance and the mutual impedance between it and one phase wire based on the equivalent spacing between the ground wire and the three phase wires of the line. The equation for the zero sequence impedance of a single-circuit, three-phase line with one ground wire is taken from Table 2 of Engineering Report No. 37 of the above Joint Subcommittee (3):

$$Z_0 = Z_{11} + 2Z_{12} - \frac{3\,Z^2_{17}}{Z_{77}}$$

Z_0 is the zero sequence impedance of the line in ohms per mile, Z_{11} is the self-impedance of one phase wire with ground return, Z_{12} is the mean mutual impedance of two phase wires with ground return, Z_{17} is the mean mutual impedance of the ground wire and the phase wires, and Z_{77} is the self-impedance of the ground wire. Although usually found from standard tables, it is interesting to note that the positive and negative sequence impedances can also be determined from the above self and mutual impedances for a single circuit line as follows:

$$Z_1 = Z_2 = Z_{11} - Z_{12}$$

Current in the ground wire can be found as a fraction of the total ground fault current through the line section involved from the equation:

$$I_{G\,8} = \frac{-Z_{17}}{Z_{77}} I_F$$

Use of these equations requires reference to the curves for the self and mutual impedances published as Fig 15 and 16 in Engineering Report No. 37 of the above Joint Subcommittee (3). These curves have been derived from Carson's equations in which certain simplifying assumptions have been made and will give results well within the requirements of engineering accuracy. No account is taken of the differences in height of power line conductors. A standard height of 40 ft is assumed and so little variation is effected by change in height that it can be neglected. Except for variations in mean spacing of the conductors, no account is taken of changes in configuration. The lines are considered of infinite length and end effects are neglected. It is important to note that uniformly low earth contact resistances are assumed in the computation of ground wire characteristics together with the usual assumptions of symmetry and transpositions. As would be expected, high conductivity ground wires have considerable influence on the zero sequence impedance of a line, though the effect of earth resistivity is less in this case than with lines having no ground wires.

For those cases where single phase faults to ground must be considered on extensive isolated neutral systems, Table 5 of Engineering Report No. 37 of the Joint Subcommittee (3) gives the equations for the calculation of zero sequence capacitance for lines, so that ground fault current computations on such systems can be made rather simply and well within the requirements of ordinary engineering accuracy.

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1. Wave Propagation in Overhead Wires with Ground Return, J. R. Carson, *Bell System Technical Journal* Vol 5, 1926, pp 539-554.

2. Calculation of Resistances to Ground, H. B. Dwight, *AIEE Transactions*, Vol 55, 1936, pp 1319-28.

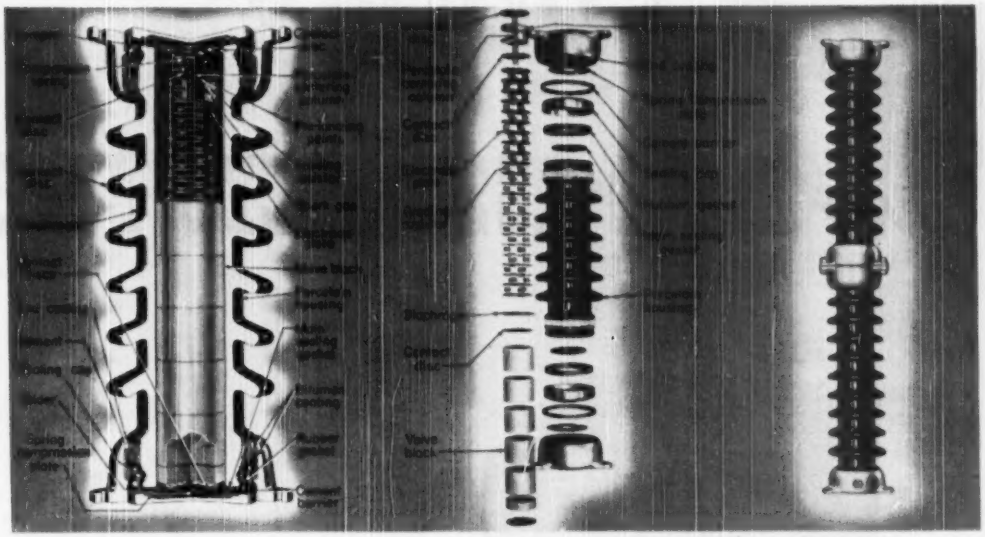
3. Zero Sequence Impedances of Power Lines and Cables, Joint Subcommittee on Development and Research, Edison Electric Institute and Bell Telephone System Engineering, Report No. 37, 1936.

Welded Transformers Need Fewer Inspections

IN RECENT YEARS Consolidated Edison Co of New York has adopted welded tank units for distribution transformers and thus has been able to extend routine inspection schedules by several months.

Routine inspections are made of these transformers to determine if the tanks are tight and the oil is in a satisfactory condition. With additional assurance of tightness for welded units, it has been possible to extend inspection periods at wet locations from three months to one year. At the same time inspections at dry locations have been extended from one year to two years for both gasketed and welded type units.

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN



CROSS SECTION of 25-kv arrester EXPLODED VIEW of 25-kv arrester ASSEMBLED 73-kv stack

New Lightning Arrester Has Better Operating Tolerance

J. W. KALB
Development Engineer
The Ohio Brass Co
Barberton, Ohio

BASIC IMPULSE insulation levels are now receiving careful re-examination. Arrester protective levels, grounding practice, relative location of arrester and protected apparatus are all of major importance to the determination of proper insulation levels.

Realizing that impulse insulation levels depend upon maximum rather than average protective levels, arresters manufacturers have been alert in seeking means to narrow the tolerance range of arrester protective levels. Thus will be realized more fully the inherent protective abilities of these devices.

Ohio Brass has obtained rights to manufacture a form of valve-type arrester that has been widely used abroad and manufactured by ASEA (Allmanna Svenska Elektriska Aktiebolaget). The arrester incorporates the basic components of modern arresters for station protection—a nonlinear valve resistor element in series with a resistance-shunted, multiple-gap element.

The arrester has these characteristics:

1—Low IR discharge voltage with less than plus 5% tolerance.

2—Low impulse sparkover voltage with less than plus 10% tolerance.

3—Ability to meet standard 10,000-amp operating duty cycle test and 100,000-amp discharge current test.

4—Permanency of initial characteristics.

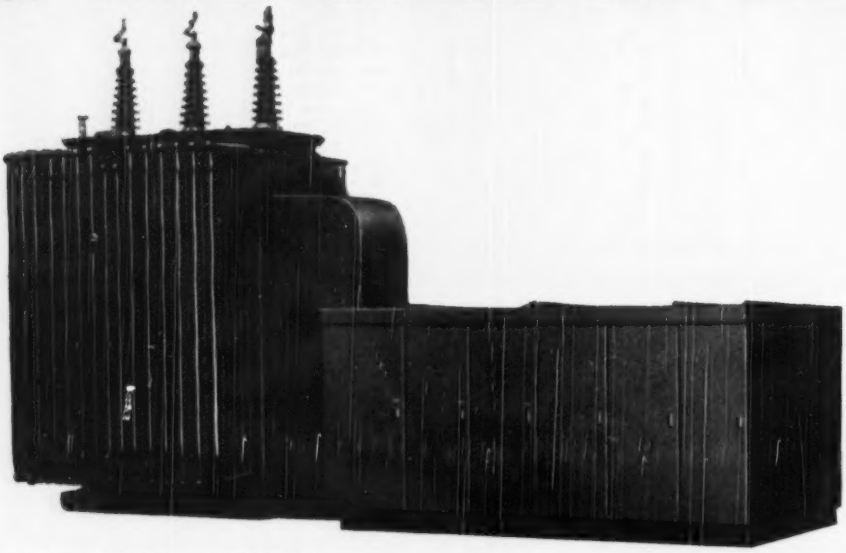
5—Simple design and economy of manufacture, making it possible to provide better protection by locating arresters at both the station entrance and major equipment with reasonable investment.

The arrester is of unit construction, and supplied in ratings of 3-kv to 121 kv rms maximum line-to-ground arrester voltage. Ratings from 3 kv to 37 kv are met with a single unit arrester. Beyond this ratipg various units are combined in stacks to satisfy requirements of lines up to nominal ratings of 138 kv, effectively grounded neutral.

Series gap structure of the arrester is one of its notable features. This compact device accomplishes low consistent sparkover, pre-ionization and high power-follow interrupting ability. Three components make up the gap structure: (1) The brass electrode plate; (2) the grading resistor-spacer; and (3) the porcelain supporting column. Symmetrically-formed depressions in opposite faces of the plate locate three spacing resistors and permit a staggered arrangement of these resistors and three

UNIT SUBSTATION

over FIELD-ASSEMBLED TYPE



Typical G-E Master Unit Substation

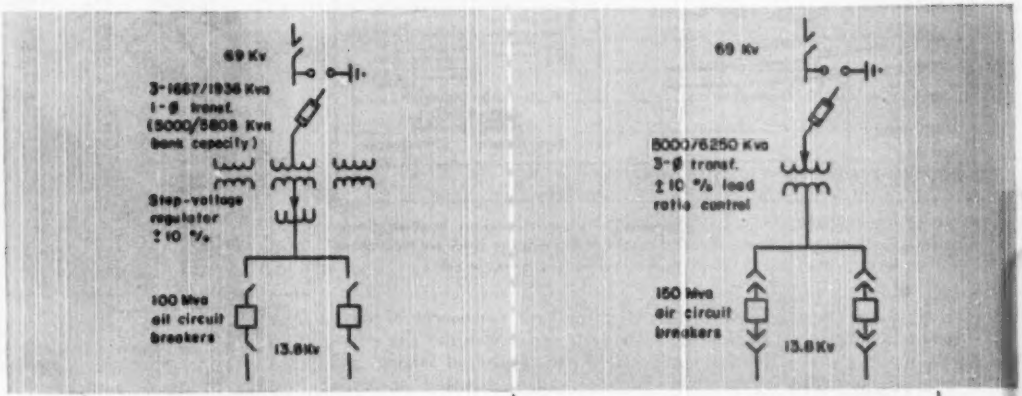
HERE ARE OTHER SAVINGS.....

When you order General Electric Unit Substations your engineering involves only a simple one-line diagram like the one at the right. We do all the detailed specs, prepare construction drawings, electrical diagrams, operating instructions and other paper work to give complete co-ordination of the project—all this on one purchase order, and at lower costs than field-assembled types.

For further information ask your G-E Sales Representative for the publications listed or write to *Apparatus Department, General Electric Company, Schenectady 5, New York.*

Master Unit Substations	GEA-3800
Single-circuit Unit Substations	GEA-4300
Package Substations	GEA-4500
Rural Package Substations	GEA-5276

SAVES 8.7%



FIELD-ASSEMBLED TYPE	
MATERIAL AND LABOR	$66,182
OVERHEAD (20%)	13,236
	$79,418

G-E UNIT SUBSTATION	
MATERIAL AND LABOR	$60,424
OVERHEAD (20%)	12,085
	$72,509

SAVINGS by installing G-E UNIT SUBSTATION $6,909 or 8.7%

In this typical cost analysis* that shows the obvious advantage of using General Electric Unit Substations purely from an investment standpoint, the labor estimates on both jobs were the minimum, a factor that favored the field-assembled type. As G-E Unit Substations arrive in large, completely-assembled units they are installed faster and easier, with lower labor costs.

Note that 20% overhead was added in both cases. For a comparison of *real costs*, 10% on the G-E Unit Substation against 20% on the field-assembled type would be more reasonable. Overhead is reduced when you order G-E Unit Substations because weeks spent in tedious engineering and detailing individual items are eliminated, at definite savings to you. Another item in favor of the G-E Unit Substation is its fan-cooled rating—442 kva greater than the field-assembled job. At a conservative $5 per regulated kva this gives you further savings in favor of the Unit Substation.

*For one installation in 1949.

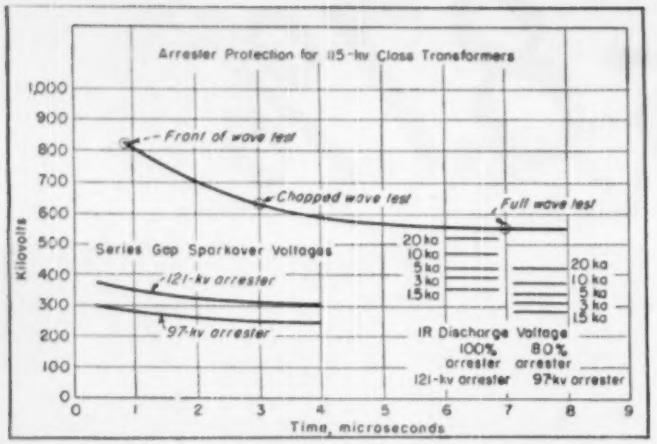
MATERIAL AND LABOR	$66,182
OVERHEAD (20%)	13,236
EXTRA FAN-COOLED CAPACITY	2,210
	$81,628

LET'S EVALUATE

MATERIAL AND LABOR	$60,424
OVERHEAD (10%)	6,042
	$66,466

SAVINGS by installing G-E UNIT SUBSTATION $15,162 or 18.6%

GENERAL ELECTRIC



PROTECTION AFFORDED by arrester at terminals of 115-kv transformer, in terms of demonstrated strength of transformers by standard impulse test. Protective levels are those shown in table for arresters rated 97 and 121-kv rms with tolerances as shown in table

Protective Characteristics of Lightning Arrester

Arrester Rating (Max line to ground voltage, kv rms)	Impulse Sparkover Voltage[1] (AIEE front of wave test)[2]	IR Discharge 5,000 Amp	Voltage[3, 4] 10,000 Amp
3	12	11	12
6	20	21	23
9	28	31	35
12	37	42	46
15	48	52	58
20	62	69	77
25	77	86	96
30	93	103	115
37	115	127	142
40	123	138	154
50	155	172	192
60	186	206	231
73	225	255	284
79	243	276	307
85	262	298	330
97	298	339	377
109	336	380	424
121	370	421	469

Notes:
(1) Tolerance: + 10%
(2) 100 Kv per microsecond for each 12 kv of arrester rating or fraction thereof
(3) Tolerance: + 5%
(4) 10x20 microsecond current wave

parallel gaps to conserve height.

Integral in each electrode plate are three accurately located ionizing tips that contact the porcelain supporting column. At elevated voltages, these tips flood the gap with an ionized atmosphere. At normal line potentials no overstresses are present. Precise gap spacing is insured by accurate ganging of both the electrode plates and the length of the spacer-resistors during manufacture. Resistance between individual electrode plates of the structure is measured at time of its assembly to assure desired voltage distribution.

Selected silicon carbide crystals form the basic component of valve blocks in series with the gap structure. Close control of mixing and high-temperature bonding processes results in valve blocks of exceptional uniformity. This is manifested in a plus tolerance of only 5% above average for IR discharge voltages. The accompanying table, columns 3 and 4, shows average discharge voltage characteristics for representative arrester ratings from 3 to 121 kv rms.

Permanence of the valve element characteristics has been demonstrated by test oscillograms. Arresters rated at 3 kv, which discharged 10,000-amp current waves, were not changed by a 100,000-amp discharge or by the standard 30-operation duty cycle test with 10,000-amp impulse.

To assure permanence of arrester protective characteristics, the interior is filled with dry, inert gas. This dry interior is maintained by two series seals, the principal seal being provided with positive spring follow-up to compensate for any possible long-time aging of gasket material.

Emergency Methods Meet Fresh Water Shortage

EMERGENCY MEASURES adopted by Consolidated Edison Co of New York have reduced fresh water consumption in electric generating stations by approximately 33%. These measures were necessitated by a water shortage, which has continued since the summer of 1949. This specific reduction was made during the first two weeks in Oct. 1949 and is the same yardstick used by New York City Dept of Water Supply, Gas and Electricity in its statistics.

Fresh water reduction methods put into effect and continuing in use are based on a few calculated risks. Some methods which have been applied at Consolidated Edison's generating stations are:

1. Daily surveys are made by Electric Production Dept to check consumption.

2. Blowdowns have been reduced.

3. Piping changes and adjustments wherever possible divert drips and drains into storage tanks to salvage fresh water.

4. Boiler make-up is kept as low as possible.

5. Overboarding of condensate in condensers has been reduced. Condensate which was overboarded at 50 ppm of chloride is now run to waste at 150 ppm of chloride. Concentrations higher than 150 ppm are inadvisable. If too much chloride is present it would result in scale formation. Risk now being taken is very slight.

6. Method of testing condensers has been changed so that salt water may be used in part of the process instead of fresh water.

7. Salt water is being used in a fly-ash disposal pump at Waterside Station.

In other locations fresh water consumption is being reduced by these methods:

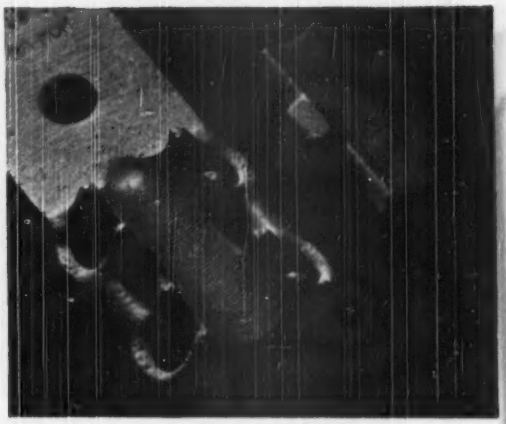
1. Automobiles and trucks are no longer washed.

GENERAL ELECTRIC POWER CONNECTORS HAVE

MACHINE-SERRATED CONTACT SURFACES

for high pull-out strength

for low contact losses



Here's the way the machine-serrated contact surfaces on G-E power connectors bite into the conductor (500 MCM tubing shown). For this test a hand wrench was used to tighten the connector (right). Tension was then applied. Above photo shows that the copper "backed up." This action assures a high-conductivity joint that will resist vibration and give positive pressure on the conductor at all times.

Disassembled G-E power connector showing the sharp serrations machined (not merely cast) into the contact surfaces—an exclusive General Electric feature. Note that all contact surfaces are silvered, another standard feature on all G-E connectors. The photo also shows the interlocking sides that confine cable strands within the conductor enclosure thus obtaining full advantage of the cable's current-carrying capacity.

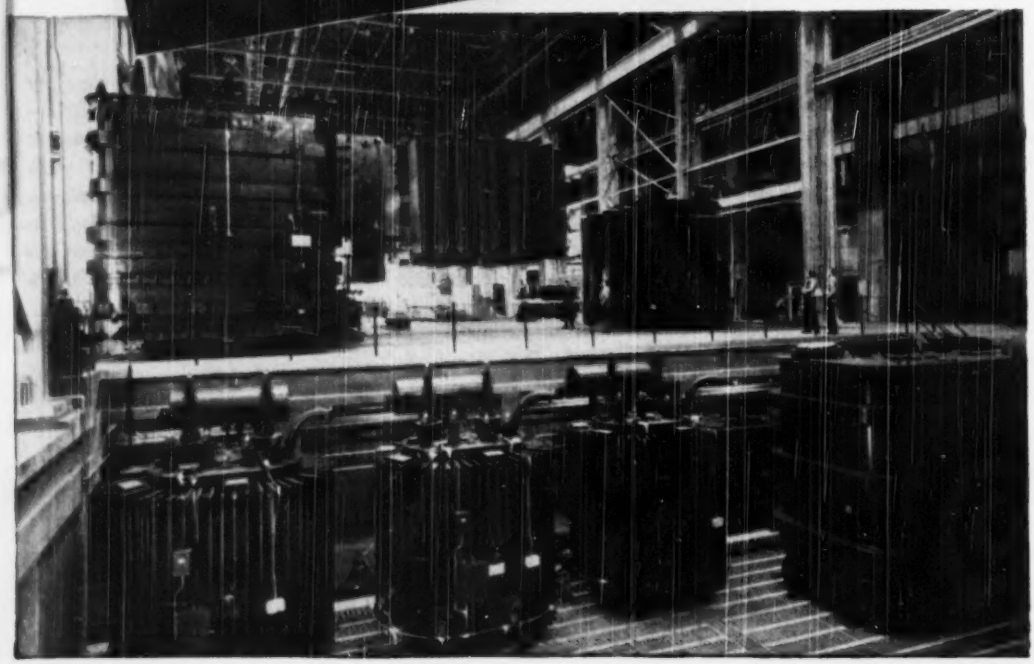
Place an order today with your G-E sales representative and start realizing the many benefits to be gained by using General Electric connectors. Also, write for a copy of bulletin GEC-400 that contains 40 pages of valuable information on G-E connectors and see for yourself how easy they are to order. Write to *Apparatus Department, Section 856-54, General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

856-54

GENERAL ELECTRIC

Lifts the Limit



1,550 KV B.I.L.

With these new manufacturing and commercial testing facilities, we are now ready to build transformers with a B.I.L.* of 1,550 kv, corresponding to operating voltages far exceeding any in use today. We have already built a 360,000-volt power transformer which we thoroughly tested, disassembled, rebuilt and completely retested, to verify design data. This transformer has a B.I.L. of 1,550 kv full-wave and 1,785 kv chopped wave. It successfully withstood repeated impulse tests at both of these values, which we believe to be the highest ever attained on a complete transformer.

*Basic Impulse Insulation Level.

250,000 KVA

With these new facilities we are ready to build transformers with ratings up to 250,000 kva at voltages above 138 kv. Such transformers can be completely and adequately tested *after* assembly—two 250-ton cranes are available to move them into the test area. Shipment limitations are eased by new 16-wheel drop-center railway cars built to our specifications. These cars will handle 336,000-pound units—about one-third heavier than the largest shipment made to date.

on Transformer ratings

with unrivaled facilities and know-how

We are just completing a several-million-dollar expansion of our large power transformer facilities. With the greater floor space, the higher bays, and the largest cranes in the electrical industry—shown at left—production capacity has been more than doubled. Equally important, transformers can now be built in much higher ratings.

If the economics of your system call for higher-rated units like these, contact your General Electric sales engineer. We have anticipated your needs and are ready and able to do the job with you. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

2. "Save Water" signs have been placed in all washrooms, near utility sinks, etc.

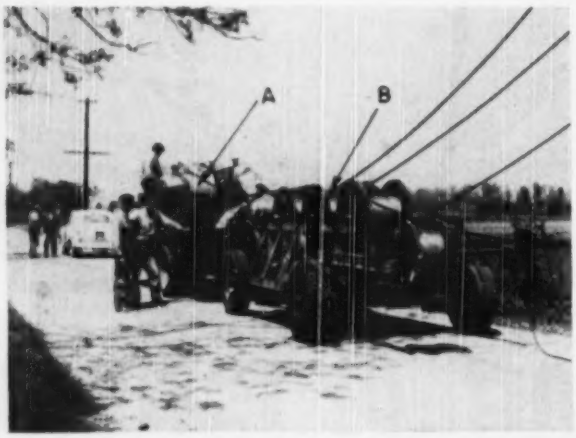
3. Washroom faucet pressure has been reduced.

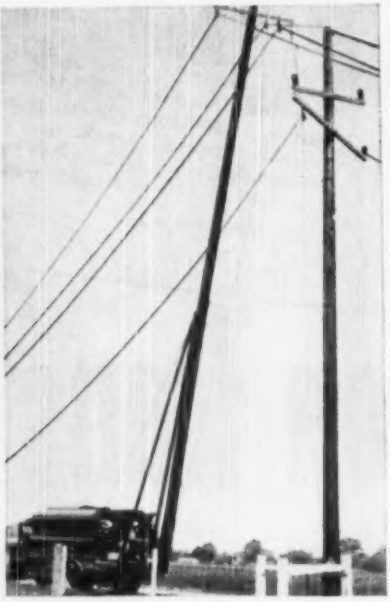
4. Floor washing in office buildings has been curtailed.

5. Water consumption of certain water-cooled compressors in transformer shops has been reduced by adjusting fittings so that units operate at higher temperatures. Experiments indicated that compressors can be operated at a temperature higher than was considered practical heretofore. No risk is involved. This change in operating procedure will in all probability be permanent.

6. Inspections are made of washrooms, utility sinks, etc, for leaks or water wastage.

• • •





WIRE STRINGING is a fast and simple operation on transmission lines of Indianapolis Power & Light Co. Truck A (above) pulls wire rig B which carries three reels of conductor and one reel of static wire. All wires are secured at starting point and are paid out as vehicles move forward. Tripod truck (right), which follows reel rig, has tall pole lashed to one leg of tripod serving as boom. Proper length of pole for boom is usually 5 ft more than height of line poles. Four sheaves on top of pole boom assist in positioning wires on crossarms of transmission poles. Finally, wires are pulled to proper sag and tied in

Pole Boom Cuts Wire Stringing Cost

RUSSELL P. MILLER
Indianapolis Power & Light Co
Indianapolis

TWO TRUCKS, a four-reel trailer and a tall pole are the main components used by Indianapolis Power & Light Co to lay simultaneously four transmission conductors in position on pole arms. This practice is considerably faster than the former method of unreeling wire on the ground, raising it to pole arms and then sagging-in and attaching it. Also, this new practice not only requires less work of skilled linemen but also makes it easier for them to do their work.

In operation the scheme is rather simple and works very smoothly. Wires are first made fast at the starting point. Truck A (above left) pulls reel rig B which carries four reels—three reels of conductor and one of static wire. Conductors are reeled out as the rig proceeds forward.

A second truck (above right), which follows the wire rig, has a boom formed by a pole lashed to the roadside leg of the pole-setting tripod. A set of blocks attached from the truck to the pole base make the boom movable so that it can be extended sideways if necessary. To make the boom movable in line with the truck a double-drum winch is used.

Boom Extends Above Pole Tops

As the truck drives along road shoulder, the pole boom top usually can be arranged to extend over tops of poles on which transmission circuit is being strung. Right length of pole for boom is usually 5 ft more than height of poles in line.

Four sheaves fastened to top of pole boom properly locate three conductors and static wire as they are paid out. Finally, wires are pulled to proper sag and tied in.

Safety Latch for Transformer Gin

C. E. MARCHANT
Northern Berkshire Gas Co
North Adams, Mass.

TO LOCK a transformer gin of the Coffing type in working position, a safety latch can be bolted to the base plate of the gin so that it will drop over the tightening handle. The latch prevents inadvertent opening of the handle after the chain has been tightened around the pole.

The latch was made from 6x1¼x¼-in. bar steel and is bolted to the gin base with a ⅜-in. bolt and washer.

Dependable, Permanent Grounding!

BLACKBURN *Copper-Bonded* GROUND ROD

Completely Covered - - - Molecularly Bonded to Steel Core---To Insure Lasting Protection

Note uniform copper covering, molecularly bonded to steel core. Cross section of copper is greater than No. 4 wire. Both point and driving end completely covered to totally protect steel.

UL LABORATORIES INC. LISTED UNDER RE-EXAMINATION SERVICE

For Your Protection!

Here is a quality ground rod from a reliable mid-western source — a stable, dependable source of supply — a strategically located source for quick shipment to central, southern and western sections of the country.

For your convenience BLACKBURN maintains numerous, conveniently-located jobber stocks, backed up by a large warehouse stock at the factory in St. Louis.

For a dependable source of a truly quality rod specify BLACKBURN when you order.

Distributed on the West Coast by
KORTICK MANUFACTURING CO.

JASPER BLACKBURN PRODUCTS CORP.
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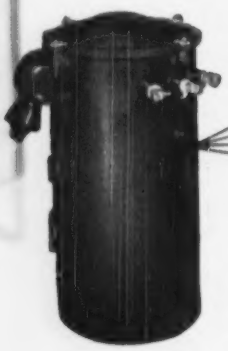
BUILDERS OF QUALITY PRODUCTS

MOLONEY TR

...all sizes in all voltages up to and including 230,000 volts

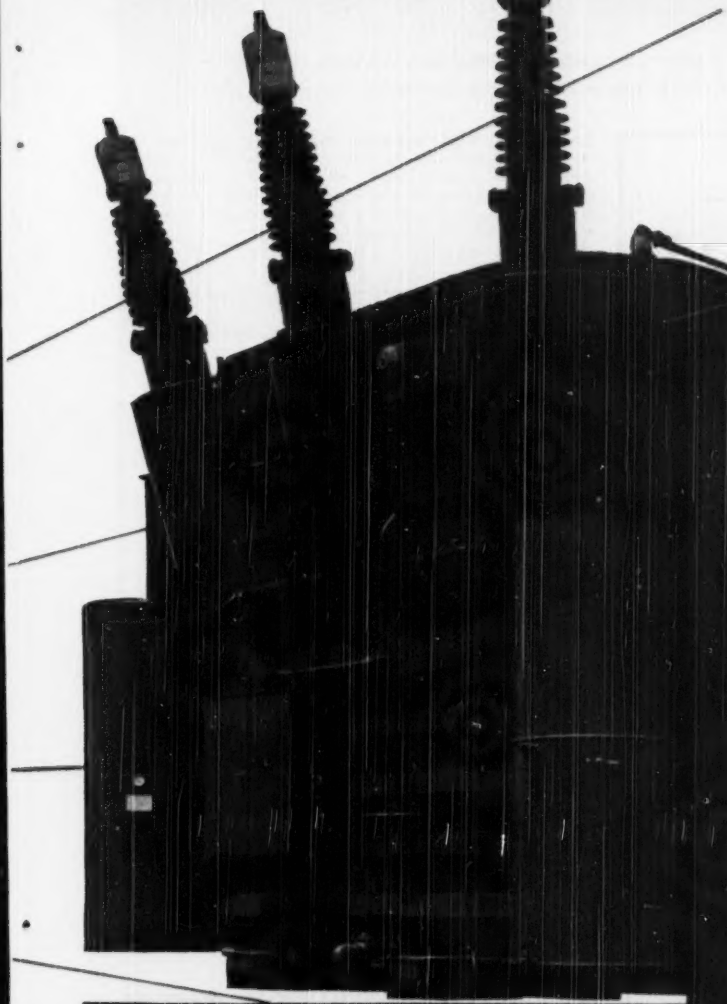


Moloney manufactures all types of transformers for Power System and Industrial applications. They are built in all Kva sizes . . . in voltages as low as 240 volts and as high as 230,000 volts.

Whatever your requirements are . . . Moloney can supply you with transformers of unsurpassed quality. The experience of over half a century of transformer manufacture . . . a policy of incorporating a high factor of safety in design . . . the use of highly skilled workmen in a plant noted for its low labor turnover . . . all combine to provide the traditionally high quality of Moloney Transformers.

Leadership in **DESIGN • RESEARCH • ENGINEERING**

ANSFORMERS



MOLONEY MAKES

- POWER TRANSFORMERS
- UNIT SUBSTATIONS
- TAP CHANGING UNDER LOAD TRANSFORMERS
- STEP VOLTAGE REGULATORS
- REGULATING TRANSFORMERS
- HIPERCORE DISTRIBUTION TRANSFORMERS (Conventional and CSP Types)
- LOAD CENTER TRANSFORMERS
- ASKAREL (Non-Inflammable Liquid COOLED TRANSFORMERS)
- AIR-COOLED (Class A and Class B Insulated) TRANSFORMERS
- CONSTANT CURRENT STREET LIGHTING TRANSFORMERS
- SUBMERSIBLE TYPE TRANSFORMERS
- NETWORK TRANSFORMERS

MOLONEY ELECTRIC CO.

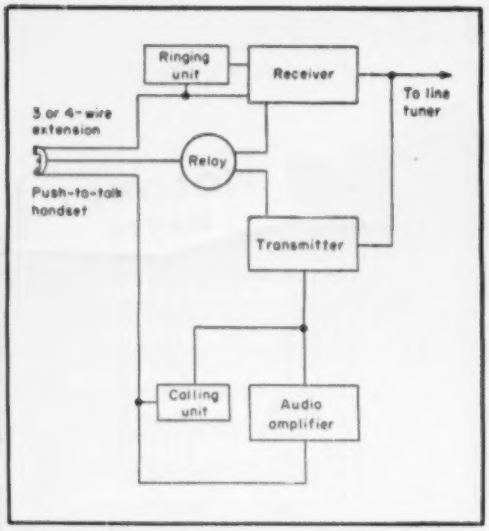
Power and Distribution Transformers Exclusively Since 1890

FACTORIES AT ST. LOUIS 20, MISSOURI AND TORONTO, ONTARIO, CANADA

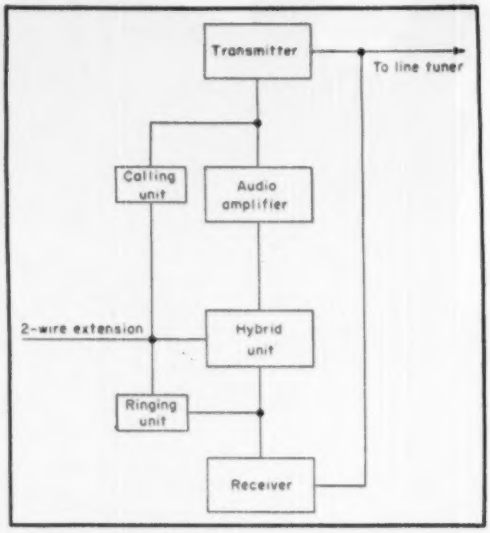
Power Line Carrier System Assemblies—I

R. C. CHEEK, Central Station Engineer, Westinghouse Electric Corp, Pittsburgh, Pa.

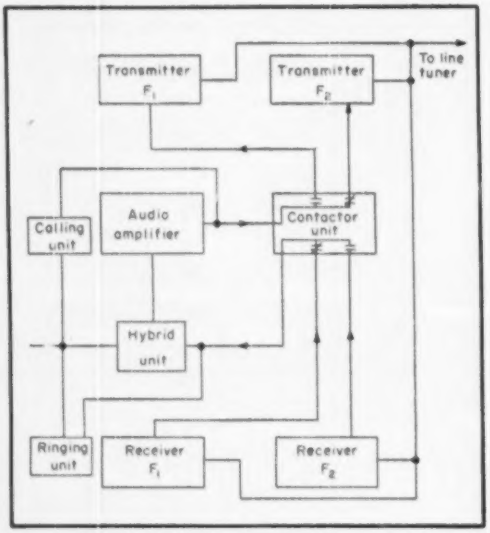
Three main carrier communication systems are outlined by basic units and elements. Another system, a coupling capacitor and a double-frequency trap, will be outlined in a subsequent issue.



SINGLE-FREQUENCY MANUAL-SIMPLEX communication assembly with code-bell calling. Transmission can proceed from one station only at any given instant. All stations on a channel operate on a single frequency. Push-to-talk button on telephone handset is used for "send-receive" switching operation, energizing transmitter and de-energizing receiver during transmission



TWO-FREQUENCY DUPLEX communication assembly with code-bell calling. Transmission can proceed simultaneously from both stations. First frequency used for transmission at one station, the second for reception. At other station, first frequency is used for reception, the second for transmission. Audio hybrid unit permits continuous operation of transmitter and receiver during conversation. Assembly operation is normally limited to two terminals per channel



MULTI-STATION TWO-FREQUENCY DUPLEX communication assembly with code-bell ringing. Communication can proceed between any two of a number of stations on a channel. Frequencies are designated F_1 and F_2. When telephone handset is picked up at calling station, contactor unit applies audio amplifier output to selected transmitter F_1. Simultaneously transmitter is energized and output of receiver F_2 is applied to audio hybrid unit. Presence of calling station carrier on F_1 prevents transfer at answering station. Transmitter F_1 and receiver F_1 at the calling station, and transmitter F_2 and receiver F_2 at the called station remain energized throughout the conversation. Hanging up of telephones at both stations returns conditions to normal, with all stations receiving on F_1 frequency

Adapted by permission of Westinghouse Electric Corp from forthcoming "Electrical Transmission and Distribution Reference Book", 1950 edition.

a product of imagination . . .

. . . with an ideal combination of electrical and mechanical properties

By working alongside folks like yourself—at design desks, workbenches, and in laboratories—we've acquired a good idea of the time, care, and imagination you pour into the engineering and production of your products. The thick-skinned insulation tube for an expulsion fuse shown here is a good example. The manufacturer wanted moisture resistance, high strength, weather resistance *plus* excellent arc resistance—all wrapped up in a material that was easy to machine. Working with him, and using a little imagination, C-D engineers came up with *two* different plastics: Laminated Dilecto Tubing for the wall, and Vulcanized Fibre for the core.

It's another example of how you, too, can depend upon C-D to engineer the right laminated plastic for your needs. For C-D has no "axe to grind." We can recommend from five basic plastics subdivided into a remarkably wide range of grades and combinations of grades to supply almost *any combination* of mechanical, electrical, and chemical characteristics. For *this* kind of help and imagination, call your nearest C-D office, any time.

your partner in producing better products

CELORON (Molded High-Strength Plastic)
MICABOND (Bonded Mica Splittings)
DIAMOND FIBRE (Vulcanized Fibre)
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Continental Diamond FIBRE COMPANY

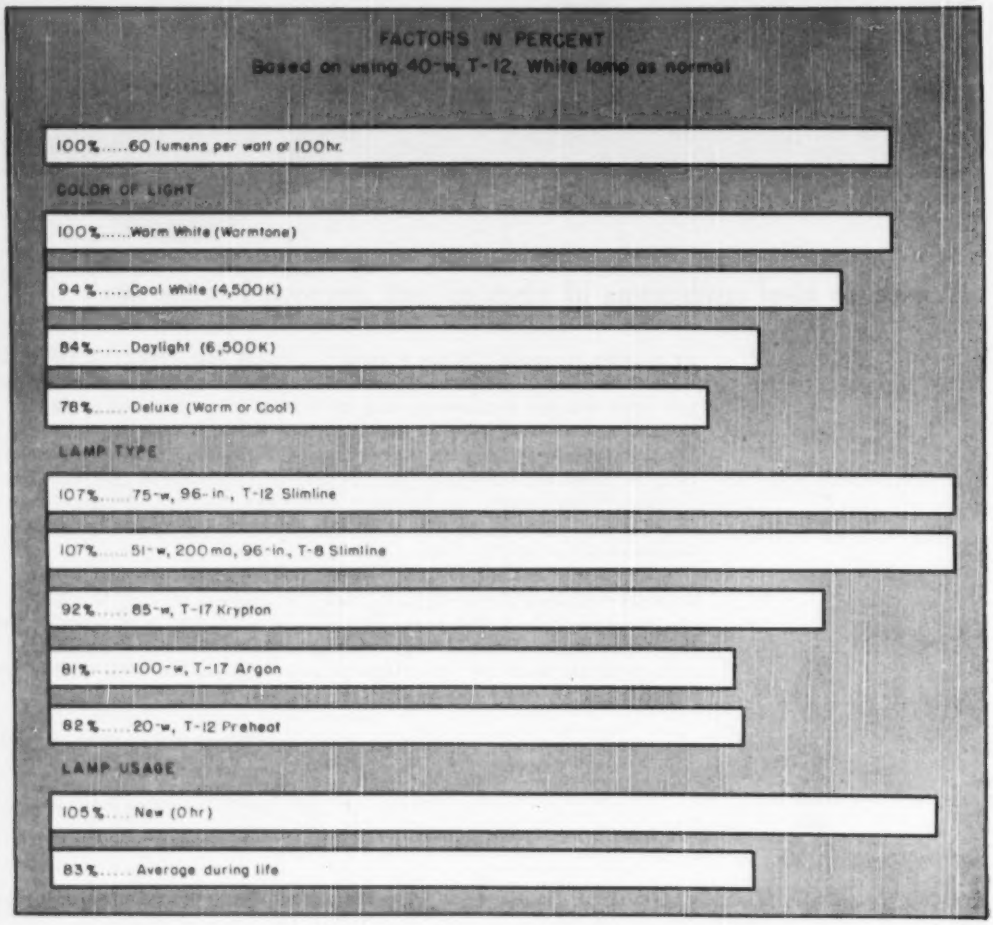
Established 1895 Manufacturers of Laminated Plastics since 1911 — NEWARK 15 DELAWARE

Factors for Calculating Light Output Of Fluorescent Lamps

R. G. SLAUER, Manager, Applications Laboratory, Sylvania Electric Products, Inc, Salem, Mass.

Using the factors in the chart, the approximate light output of a given fluorescent lamp may be easily determined by substitution in the formula:

Lumens output = Watts x 60 x Color Correction x Type Correction x Usage



EXAMPLE 1

What is the average lumen output during life of a 100-w, T-17, cool white F lamp?

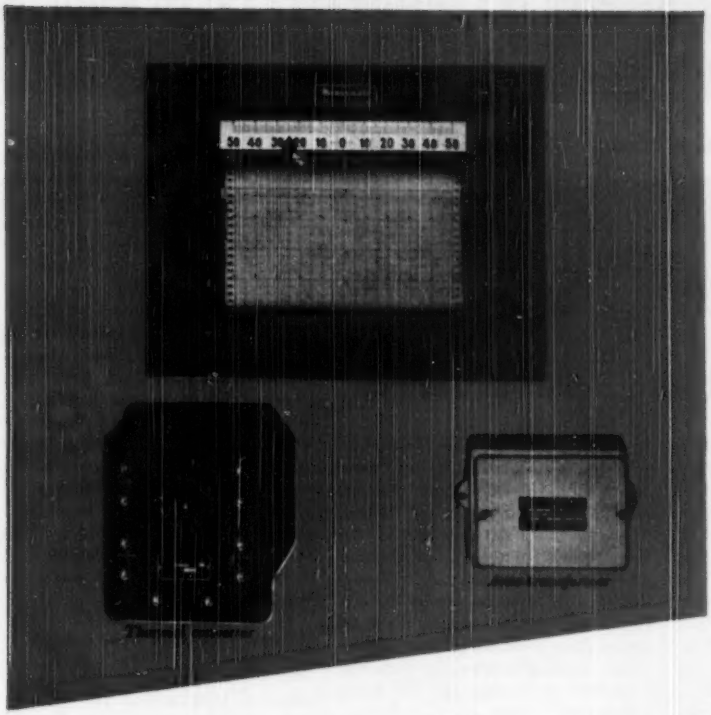
Lumens = 100 x 60 x 0.94 x 0.81 x 0.83
= 3790

EXAMPLE 2

What is the lumen output of a new 75-w, T-12 Warmtone slimline lamp?

Lumens = 75 x 60 x 1.05 x 1.07 x 1.00
= 5050

Keep A Weather Eye On All Three



1 Individual Generator Output

2 Total Station Output

3 System Loads and Trends

...With This *ElectroniK* Recorder and special components

CONTINUOUS indication and recording of power generated is of prime importance to the operation of every central station.

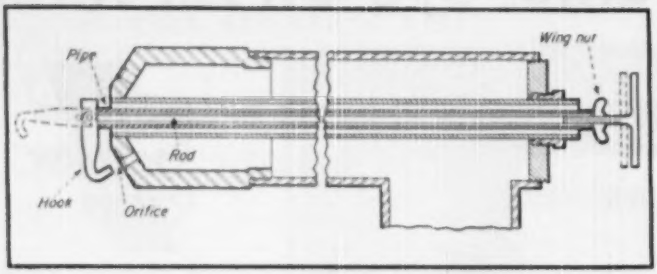
The *ElectroniK* Strip-Chart Recorder, using a thermal converter, accurately provides such vital information when used as a wattmeter. And . . . with the help of a phase shifting autotransformer and a thermal converter . . . it can be used as a varmeter, for accurate recording of the non-useful energy generated.

Total result: a preventive check on generator overloads; immediate information for load dispatching; easily filed tabulation of interchanged power.

This is another indication of how the Brown approach to instrumentation offers positive steps toward the maintenance of maximum operating efficiencies. For more detailed information, call in your local Honeywell engineer . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4568 Wayne Ave., Phila. 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

Honeywell
BROWN INSTRUMENTS



ORIFICES in gas burner tips are cleaned with boiler in service by movable hook on the end of tool. With hook in horizontal position, the tool is inserted in center tube from which oil burners have been removed. Hook is dropped 90 deg and wing nut is tightened. Each orifice is then punched out by inserting hook and pulling back on tee handle

Burners Cleaned with Boiler in Service

WHEN OIL is burned as a standby fuel at the Ripley Plant of Kansas Gas & Electric Co, gas burner tip orifices become stopped up with carbonized oil. Before burners are returned to gas fuel, they have to be cleaned to restore their capacity. Since burners are not removable with boiler in service, the tool illustrated was developed to clean orifices with burners in place.

In operation the wing nut is screwed out toward tee handle, allowing the hook to be positioned as shown by dotted lines on the illustration. The tool is inserted in the tube from which oil burners have been removed and the hook allowed to fall 90 deg. When the wing nut is tightened, the hook is held in the 90-deg position against the pipe on the rod.

Each orifice in the burner tip can be punched out by inserting the hook and pulling back on the tee handle. When cleaning is done, the wing nut is backed off to allow the tool to be withdrawn.

Insert Safety Rules in Rubber Gloves

TO INSURE more careful use of rubber gloves after delivery to linemen, New England Electric System Central Laboratory, Worcester, Mass., inserts in each pair of gloves a 4 x 11-in. sheet bearing this information—

YOUR LIFE IS ON YOUR HANDS
SO TREAT THESE GLOVES WITH RESPECT

They have been carefully tested by the Central Laboratory for your protection. Here are a few helpful reminders to protect you in field use:

Use your rubber protective equipment in accordance with N. E. E. S. Safety Instructions.

Don't wear rubber gloves inside out, as this causes mechanical strain in spots and lessens resistance to puncture.

Always use leather protectors over the gloves.

Inspect both protectors and gloves frequently, inside and outside, for splinters, metal slivers, or other foreign particles that could puncture them.

Give gloves an inflation test each day before using.

Do not allow oil or other greasy substance to come in contact with your rubber protective equipment.

Store them in a cool, dry place and keep them out of the direct rays of the sun as much as possible. Sunlight causes cracking and accelerated aging.

Be sure your gloves have been tested as scheduled.

Why Georgia Power Co Patrols Lines by Air

T. J. ALLEN
Supt of Transmission
Georgia Power Co
Atlanta

AIRPLANE PATROL of transmission lines averages about 60¢ per mile, or approximately 31% of the cost of usual foot patrol, and is more reliable than foot patrol, according to the experience of Georgia Power Co. Experienced patrolmen report that defective pyrex insulators which cannot be seen from the ground can be detected from the air. Many cases of potential trouble which have been located from an airplane would have caused a line failure had foot patrol been relied on. Insulators shattered to a nub, poles broken by automobiles and trees cut down on the line 35 miles from the source have been located by air and repaired in three hours. By comparison, it would have taken three days just to make the foot patrol.

Formerly Patrolled Once a Month

Standard practice had been to patrol all transmission lines at least once every month and following any flashover or temporary fault which caused the oil circuit breaker to operate. But patrol schedules were getting behind. Houses were being completed on the right-of-ways before we knew they were started; interruptions were prolonged because adverse right-of-way conditions hampered the patrolmen. A few of the districts of the company had experimented with air patrolling, both routine and for emergencies, and were pleased with the results. We also made short test flights to satisfy ourselves that line defects could be made.

There still were questions to be answered, however. Our company is organized in territorial divisions, each responsible for it's own maintenance and operation. Aircraft Service Operators trying to promote the work naturally wanted a state-wide contract. There seemed to be some merit and saving in such a contract. We decided to make a complete state-wide test patrol of our lines with a Transmission Line Engineer as observer.

The state-wide air patrol was made

HI-TENSION NEWS *Junior*

Again, O-B was the
CHOICE OF INSULATORS
. . . for 50,000 good reasons!

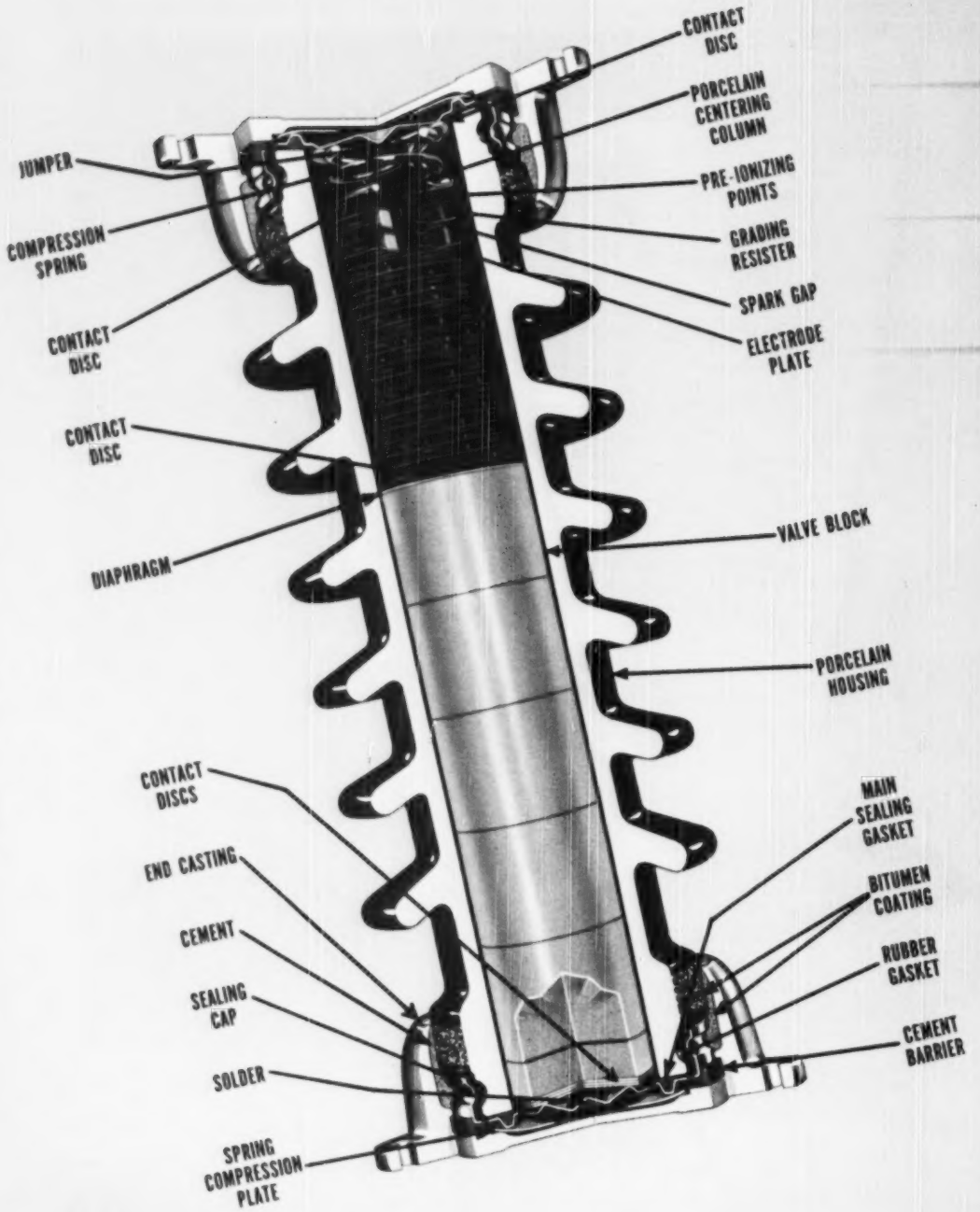
In 1928 the original portion of this 132-kv system was built, soon totaling approximately 90 miles. In the intervening 23 years, the network has almost quadrupled in circuit-miles, every tower of which is equipped with O-B suspension insulators. Nearly a quarter of a century's experience with upwards of 50,000 insulators leaves little room for sales arguments--there's nothing we can tell this power company about O-B insulator performance they don't already know. That's why it's significant that O-B again went up on this recent extension!

This is just one more case to prove that the more you know about O-B, the more it becomes your CHOICE OF INSULATORS.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

THOREX


CONTACT DISC
PORCELAIN CENTERING COLUMN
PRE-IONIZING POINTS
GRADING RESISTER
SPARK GAP
ELECTRODE PLATE
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COMPRESSION SPRING
CONTACT DISC
CONTACT DISC
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VALVE BLOCK
PORCELAIN HOUSING
CONTACT DISCS
END CASTING
CEMENT
SEALING CAP
SOLDER
SPRING COMPRESSION PLATE
MAIN SEALING GASKET
BITUMEN COATING
RUBBER GASKET
CEMENT BARRIER

★ Less than +5% IR discharge tolerance

★ Less than +10% sparkover tolerance

★ Discharge capacity—100,000 amperes

(8 x 10 microsec wave, AIEE Std. 28-A)

★ Passes 10,000 ampere duty cycle test

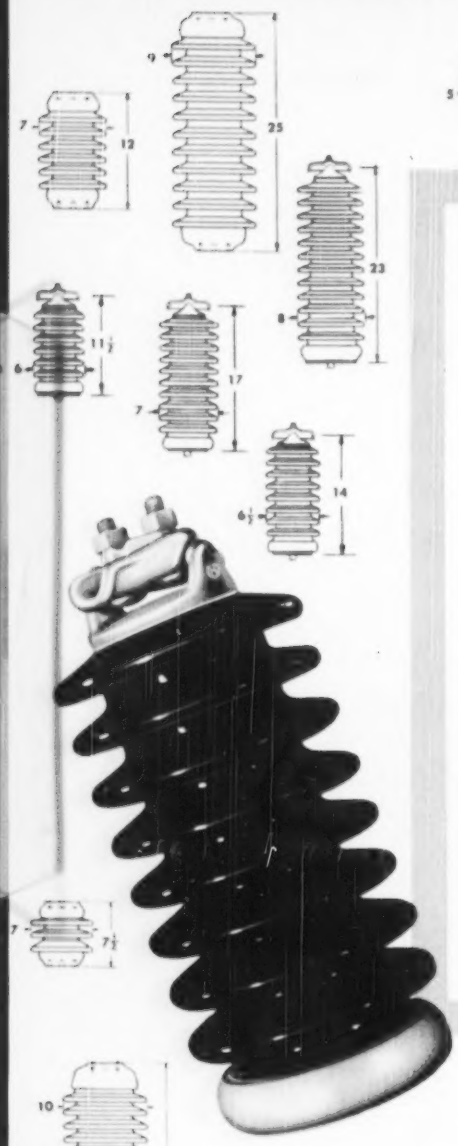
(10 x 20 microsec wave, AIEE Std. 28-A)

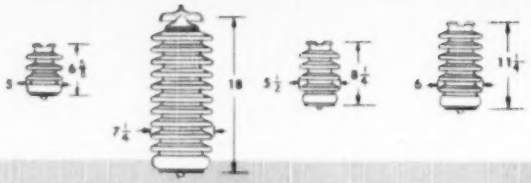
THIS COMBINATION OF VALUES IN A HEAVY DUTY VALVE TYPE LIGHTNING ARRESTER IS RADICALLY NEW ON THE AMERICAN MARKET - - - - NOW AVAILABLE FOR THE FIRST TIME IN THE O-B THOREX - - - - SEE YOUR O-B REPRESENTATIVE FOR COMPLETE INFORMATION

Ohio Brass

MANSFIELD, OHIO

HI-TENSION NEWS *Junior*



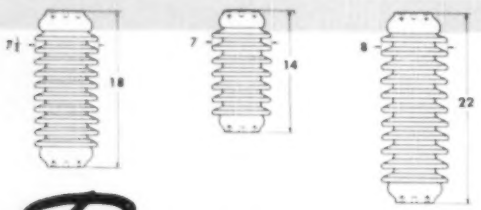


Whatever Post You Need... it's in O-B's Complete Line

With the completion of new plant facilities totaling well over a million dollars--a large share of which was devoted to departments manufacturing post type insulators--Ohio Brass is now producing, selling, and stocking a complete post series in both line and station type. This greatly enlarged production has been combined with eleven years of post manufacturing experience to make the present O-B post a major item in the O-B insulator line.

From O-B you have a free selection of any insulator type to suit your preference or standards--each brought to the highest possible degree of modern refinement and maintained at this point by unequalled laboratory and research facilities. O-B is in the unique position of being totally impartial in the application of technical development, as well as in the matter of making the best recommendations to prospective purchasers.

Your O-B representative will supply full information on the application of O-B posts either to your lines or stations. Discuss this matter with him, or refer your inquiry direct to the home office.



Ohio Brass

MANSFIELD, OHIO, U. S. A.

3042 H

in March and April, 1948 and the results justified its continued use. However, it was found that the work should be left with the divisions. They were authorized to patrol by plane provided the air service company would contract to meet our liability and pilot specifications. Because other work had to be provided for many of our patrolmen, our transition to air patrol has been slow. At the present time air patrol is being used in four of our six divisions. The Atlanta Division is too congested for its use and no qualified Aircraft Service Operators are located in the other. We patrolled approximately 27,000 miles of line during the first nine months of 1949.

Accurate as Ground Patrol

The author recently interviewed division superintendents, air patrolmen and pilots to get first hand information of the results of 18 months' experience. They all agree that all normal pole line defects can be noted, except the condition of the pole at the ground line. So far as pole line defects are concerned, we are satisfied that air patrol is as accurate or more so than ground patrol.

The average cost of the state-wide test was 55¢ per mile. Actually, the cost is now running about 60¢ per mile. This difference exists because, on the state-wide test one observer was able to disregard all divisional lines, thus eliminating most of the "dead flying." We believe the extra cost is justified because we have a number of planes under contract in various parts of the state that may be called for emergencies.

60 Mph Satisfactory

To properly inspect the line, flying must be done within 100 to 150 ft of the line, or as close as tree tops and other obstructions will permit. However, flying this close to the ground increases the danger of encountering downdrafts. We believe that flying at 60 mph (about 10 mph above stalling speed) should afford complete control of the plane and should not seriously affect observation of the line. If there is any question, the plane can circle the structure for a recheck.

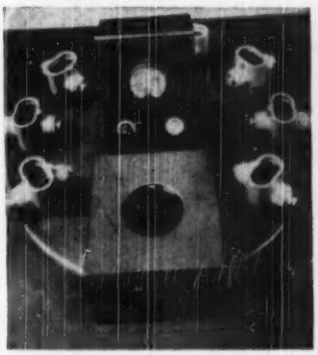
Weather conditions are the most important factors in safe air patrolling, but they are so variable that limiting conditions of wind velocity, cloudiness, rain or sunshine cannot be established. However, we do know that conditions are best in the early morning.

We require that pilots have a commercial license and sufficient experience to fly at the low altitude required. Tandem-seated, high wing, 65-hp light planes, similar to Piper Cub or Aeronca Champion planes, are well suited for the work, but 85-hp planes of a similar type with "climbing" type propellers and extra gas tanks are recommended.

Number Every Tenth Structure

The use of small portable radios on emergencies eliminates the necessity of going back to a landing field to report. If the break is in an isolated spot, the observer can direct the line crew to it. All observers agree that every tenth structure should be numbered on the face of the arm for quick identification.

We believe monthly air patrolling, supplemented by an annual foot patrol to check the pole condition, will give us a better job than was done by foot patrol alone. Furthermore, if we are willing to sacrifice some of the economy by insisting on safe flying, patrolling transmission lines by plane is here to stay.



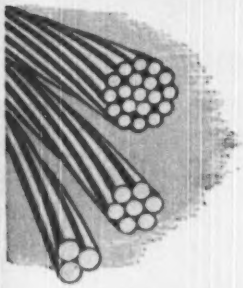
TEN-CUP semi-automatic oil tester made by Toledo Edison Co saves approximately 320 hours annually over usual one-cup tester

Multiple-cup Oil Tester Increases Test Efficiency

A 10 CUP semi-automatic tester has been made from spare parts and equipment. Each year over 2,400 samples of oil are brought in and tested, each requiring at least three breakdowns to determine the average kilovolt value. A conventional one-cup

PAGE

Stainless Steel STRAND and Stainless-Copper CONDUCTORS



Here's WHY they Save

Compared with other types strand of equal breaking strength, they . . .

- have 30-40% greater overload capacity within elastic limit
- resist corrosion all the way through —not merely through a thin case of soft metal
- offer highest tensile and vibration-fatigue strength (tensile strength 235,000 psi; corrosion-fatigue limit 50% of ultimate)

Here's HOW they Save

- They permit longer spans—therefore require fewer poles per mile.
- Being lighter, they are easier and faster to install in the field.
- More resistant to destructive factors, they last many times as long before replacement.

Let us tell you the whole story—specific data, prices, recommended sizes.

ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

NOW! the transformer of the future

ELECTRICAL WORLD

FUTURE POSSIBILITIES

. . . It is to be expected that such activity (improvements) will continue in the future. Much of it can probably not be foreseen at this time. There are a few items, however, which might be mentioned as either distinct possibilities or highly desirable.

There is considerable promise of the production of a dry-type distribution transformer for pole top installation. The advantage will be less weight and lower maintenance. It seems possible that on such a transformer the case might be reduced to a minimum or perhaps be eliminated entirely.

MARCUS

DRY TYPE AIR COOLED

LIGHTER! SMALLER! SAFER! MORE ECONOMICAL!

AIR-COOLED TRANSFORMERS EXCLUSIVELY

1 to 2,000 KVA up to 15,000 Volts to meet Individual Requirements

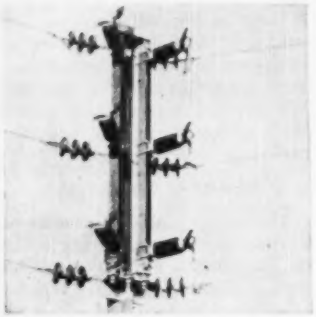
- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING

MTC

MARCUS TRANSFORMER CO.
INC.
32 MONTGOMERY STREET
HILLSIDE 5, NEW JERSEY

MARCUS TRANSFORMERS CONFORM TO THE STANDARDS OF N E M A AND A I E E

tester would require 400 hr to do this, compared with 80 hr for this ten-cup tester. Voltage range is 0-40 kv. A high-speed circuit breaker automatically opens the primary circuit when the oil breaks down. Experience has shown that this piece of equipment is safe and has greatly increased testing efficiency.



VERTICAL, wood-mounted 33-kv line switches have replaced horizontal, steel-mounted types in suburbs. No new switch has failed due to lightning in the last ten years

Vertical Line Switches Cut Lightning Outages

H. MacVAUGH
Philadelphia Electric Co
Philadelphia

VERTICAL, wood-mounted, 33-kv line switches have eliminated the phrase "tripped and won't hold" from load dispatcher's reports covering any 33-kv transmission line feeding suburban Philadelphia during a lightning storm.

Outages and poor service characteristics of many lines continued until vertical switches were used even after application of a program to improve pole-top insulation.

During more than ten years in which this type of switch has been used, no switch has failed due to lightning. In addition, both the improvement in service and system stability, and the reduction of line maintenance costs due to switch failures have been considerable.

When the old horizontal, steel-mounted type of line switch was replaced with the new vertical type, good results were immediate—switch troubles decreased at about the rate that old types were eliminated. At present, all 33-kv line switches are wood-mounted verticals.

ONE SOURCE: VICTOR

For distribution insulators and line hardware

YES, you can rely on VICTOR *alone* for *all* your distribution insulator and line hardware requirements . . . from pintype, spool, guy strain and dead-ending insulators, to strain and angle clamps of the highest quality. And, when you standardize on VICTOR, you—

CUT DISTRIBUTION COSTS 2 WAYS

1. *Less maintenance*—because these distribution insulators are ruggedly designed and made of the best "high voltage" porcelain to give you continuous, *trouble-free* performance under *all* kinds of operating conditions.

2. *Fewer replacements*—because each distribution insulator is thoroughly inspected and rigidly tested at *every* point of manufacture. This *guarantees* you top performance on-the-job.

So, on your next distribution job, standardize on VICTOR.

Now Available—

VICTOR'S ALL-NEW CONDENSED CATALOG

Write for your copy today!

LOAD BUILDING

RESIDENTIAL • RURAL
COMMERCIAL • INDUSTRIAL

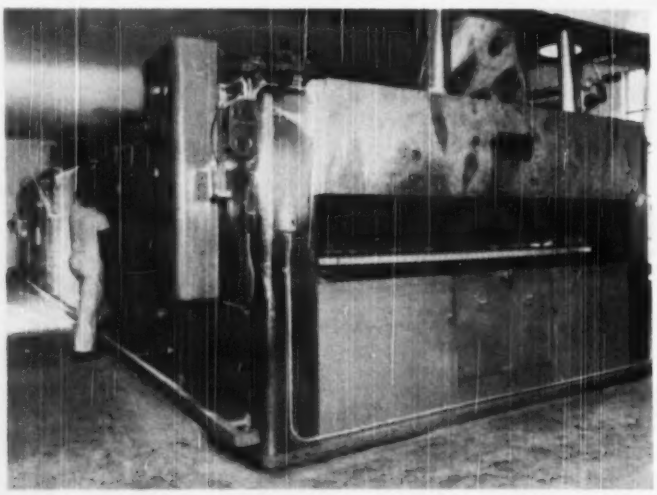
Wiring Modernization Promotion is Repeated

ELECTRICAL CONTRACTORS in the Philadelphia area are again enlisted in wiring modernization. A series of prizes for distributors' salesmen was an extra campaign feature

So successful last fall (Electrical World, Oct 8, 1949, p 136) was the Electrical Association of Philadelphia in enlisting contractors in a campaign for modernization of wiring in existing homes that the promotion was repeated. It ran from March 30 to June 30.

Again cooperating contractors were named in advertisements in metropolitan and local newspapers, provided with sales helps, were offered cash awards on point scores for various wiring improvements they installed, and were eligible for 10 prizes totalling $400. To help pay promotion costs and give feeling of a real stake, contractor again put up $25 as the price for drawing cards. Distributors' salesmen were also paid for contractors they signed up.

Largest Bake Oven Attains 69% Efficiency



EFFICIENCY of 69% has been realized in the first months of operation of this 400-kw traveling tray-type electric bake oven installed in the Silver Loaf Bakery, Spokane, Wash. With a capacity of 4,000 loaves per hr. it is believed to be the largest electric bake oven built to date anywhere in the world. Automatic controls have resulted in high uniformity

POWER SALES IN INDUSTRY

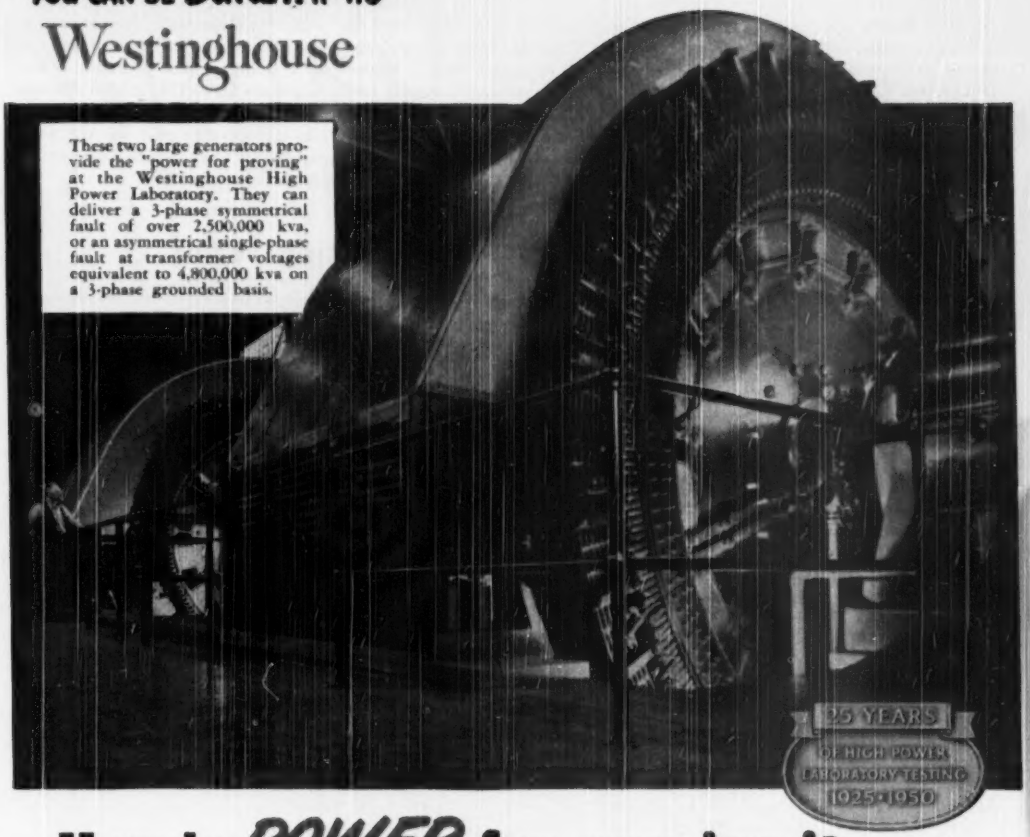
W. A. NEWMAN
Washington Water Power Co
Spokane, Wash.

Reduced labor costs, savings in investment and storage space, and absolute uniformity of finished product have been realized through the exclusive use of electric equipment in the Silver Loaf Bakery, Spokane, Wash. Recent installation of a 400-kw traveling tray-type oven increases total connected load of the bakery to 894 kw—of which 714 is baking capacity.

The electric oven eliminates the need for firing or attending to burners, since its heat control is completely automatic. Flexibility and accuracy of the heat control assure even baking, and prevent any burnt or un-

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



These two large generators provide the "power for proving" at the Westinghouse High Power Laboratory. They can deliver a 3-phase symmetrical fault of over 2,500,000 kva, or an asymmetrical single-phase fault at transformer voltages equivalent to 4,800,000 kva on a 3-phase grounded basis.

Here's *POWER* for proving it

Many electrical products are required to interrupt heavy currents under fault conditions . . . carry great amounts of current for a short time . . . perform consistently under repetitive short-circuit conditions. Oil circuit breakers, air circuit breakers, reactors, disconnecting switches, transformers, and many other pieces of electrical apparatus come under this classification.

That is why, 25 years ago, Westinghouse installed its High Power Laboratory at East Pittsburgh. We wanted to be sure that every piece of apparatus bearing the Westinghouse name was designed to function properly under short-circuit conditions.

In this High Power Laboratory we have the equipment to do this . . . huge generators to develop fault currents that match those of the country's largest electrical systems, transformers that produce short-time currents to test apparatus for momentary current rushes. This is how we make *sure*...and this sureness is passed along to you.

SEE FOR YOURSELF!

Booklet B-4383 describes facilities, procedures and actual tests conducted at the Westinghouse High Power Laboratory. Ask your Westinghouse representative for a copy, or write directly to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60722

Westinghouse
HIGH POWER
LABORATORY

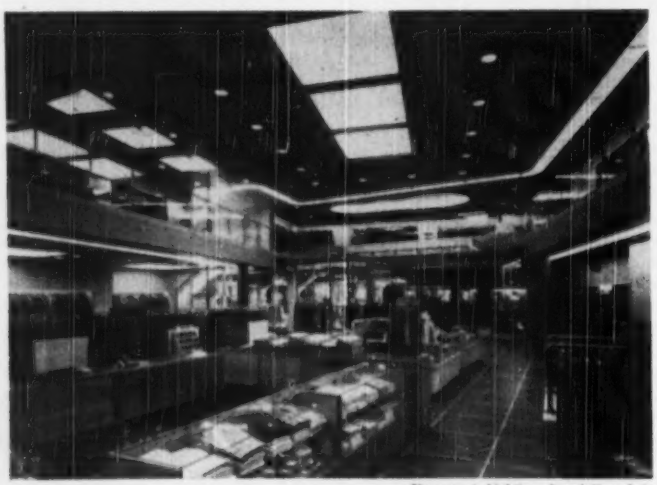
der-done loaves. The oven provides maximum output with minimum floor space, and requires no investment in fuel storage tanks or pumping equipment. Uniformity in the finished baked product due to the automatic controls assures a high quality, well-baked loaf of bread.

For the period from Nov. 1949 to April 1950 actual cost of energy supplied by Washington Water Power for the oven averaged 7.6 mills per kwhr. Production records indicate that 100.2 kwhr (equivalent to 342 Btu) are required to bake each one-pound loaf of bread. Comparison with the theoretical requirement of 235 Btu per loaf gives an efficiency of 69% under present operating schedules from 8:00 AM to 1:00 PM and from 6:00 PM to midnight. Continuous use of the oven for the same number of hours would improve the efficiency appreciably.

Flexibility Is Feature of Advertising Series

NOT 15, but 60, advertisements are included in the series above, used in local newspapers in this spring by the Northern States Power Co. Each ad is matted in 1-, 2-, 3-, and 4-column sizes, for insertions as local circumstances determine. The economy in production is apparent

Interesting Pattern with Cold Cathode



Fluorescent Lighting Association photo

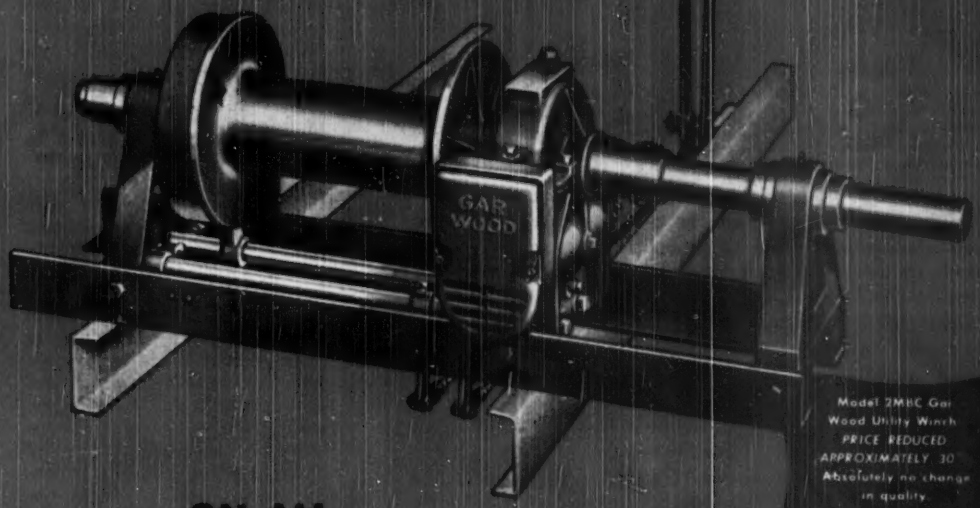
SUPPLEMENTED by incandescent down lights, cold cathode tubes display their effectiveness as illuminants and adaptability to structure of store of Crawford Clothes in Philadelphia

Load Building Notes

In the service area of the Pennsylvania Power & Light Co—9,300 sq mi, 500,000 total customers—there were sold in the first quarter of 1950, 9,652 electric refrigerators, 3,740 ranges, 1,349 water heaters, 337 dishwashers, 183 waste disposers, 1,512 home freezers, 899 roasters, 2,212 automatic washers, 7,842 non-automatic washers, 263 clothes dryers, 660 ironing machines, 3,911 vacuum cleaners, 263 bed coverings, 10,121 radios, and 8,407 television receivers.

Dealer reports of major electric appliance sales in Nashville, Tenn., for May, 1950, not yet complete, show highest-ever record. Over May, 1949, total sales are 2,873 items as against 2,416. For ranges, sales are 661 vs 606; for water heaters, 671 vs 532; for refrigerators, 1,486 vs 1,241; for home freezers, 55 vs 37.

PRICES DOWN!



Model 2MBC Gar Wood Utility Winch
PRICE REDUCED APPROXIMATELY 30%
Absolutely no change in quality

ON ALL

GarWood

WINCHES, CRANES AND POLE DERRICKS

Prices are down, but quality is still up! Even though Gar Wood reduced prices from 5% to 30%, there has been no change in material specifications and design. The same high standard of Gar Wood quality is maintained in every detail. Gar Wood Winches, Cranes and Pole Derricks are by far the "best buy" you can make.

ASK YOUR NEARBY GAR WOOD DISTRIBUTOR OR BRANCH TO QUOTE ON YOUR NEXT ORDER. THEIR LOW PRICE WILL PLEASE YOU.

GAR WOOD INDUSTRIES, INC. Wayne Division, Wayne, Mich.

PRODUCTS—HOISTS • DEEP DIGGERS • WINCHES • CRANES • TRACTOR HYDRAULIC
HITCHES • SHOVELS • EXCAVATORS • SPREADERS • TRUCK PATROLS

4316

Installation of Pinco L 735's at the Illinois Power Company's North Decatur, Ill., 138 KV Sub-Station. Prize winning photo submitted by J. W. Hickman, Draftsman for the Illinois Power Company.

A few years back, all switch and bus units were made with a short second shell which invited the possibility of cascading in stacks. That is, up until Pinco introduced the revolutionary new L 735 switch and bus stacking unit. With rugged porcelain, a larger second shell and an improved center design, this new unit showed far superior flashover performance and greatly reduced the tendency to cascade. It also provided added leakage protection and increased mechanical strength.

Today, this idea like many others pioneered by Pinco, is an accepted industry standard . . . further evidence that Pinco is constantly primed to keep abreast of industry requirements. So whether your insulator requirements are ordinary or extraordinary—the services of the entire Pinco organization are yours to command.

See Page 118 Pinco Catalog No. 49
for complete electrical and mechanical specifications.

The Porcelain Insulator Corporation
761 Main Street, Lima, N. Y.

Sales Agents: JOSLYN MFG. & SUPPLY CO.
Offices in Principal Cities

PINCO INSULATORS

Suspension Insulators . . . Switch and Bus Insulators . . . Distribution Clamps . . . Distribution Pin Types and Guy Strains . . . Transmission Line Fittings . . . Tree Insulators . . . Transformer and Circuit Breaker Bushings . . . One Piece and Multi-part High Voltage Pin Types . . . Suspension and Strain Clamps . . . Indoor Bus Support Porcelain . . . Lightning Arrester Porcelain.

• 1920 Thirty Years Service to the Electrical Industry 1950 •

INDUSTRIAL BRIEFS

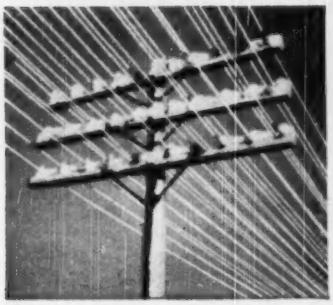
Radiant Glass heating panels produce a better product at lower cost at Hydro-Carbon Industries, Bradford, Pa., manufacturers of petroleum roadside flares. Eight heating panels are used in a simple and compact oven having a total load of 17 kw. Petroleum mixture in ¼ pint cans is run through the oven on a conveyor and 0.6 lb of water per gal of mixture is driven off. In an eight hour shift 7,200 cans are thus dehydrated by the oven.

Static Eliminators completely eliminate fire hazard and danger to operators and permit printing at high speeds on combinations of vinyl sheeting and paper at Western Products, Inc, Newark, Ohio. The increase in running speeds made possible by the static control equipment paid for it several times in the first 30 days of operation. During six months operation no trouble has occurred.

Heating Cable keeps water pipes open in 88 water service boxes during freezing weather at the Union Terminal in Cleveland. Buried under the platform and out in the coach yards, these boxes used to freeze up and burst their pipes with discouraging regularity. Sixty feet of heating cable (400 w) is wrapped around the pipes in each box in 12- and 15-ft elements. Results have been so good that the heating cable has recently been added to exposed valves and piping of condensers and after-coolers of the two large air compressors that supply compressed air throughout the station.

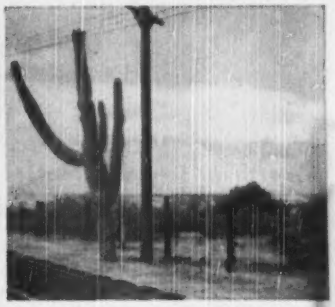
Electrostatic Spraying doubles production capacity, cuts rejects 70% and provides better working conditions for employees at Lee Metal Products, Baltimore, Maryland. Steel cabinets and other projects are conveyed thru a "coating zone" where uniform coatings are ensured by an automatic system of revolving the pieces. Very little spray is lost to the atmosphere by this method—so little, that operator does not have to wear a mask and can work continuously. A 180-kw infrared oven is used for degreasing and another oven of 160-kw for drying and baking are used in this work.—Electric Heating Bureau, Gas & Electric Co, Baltimore.

WHEREVER YOU USE WOOD..



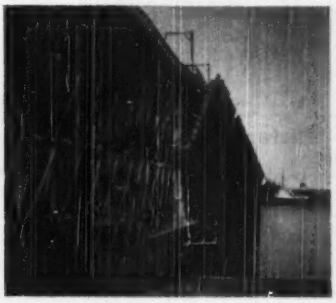
IN THE NORTH, poles must resist the tremendous weight of frequent sleet storms. Avoid preservatives which *weaken* the wood. Barrett* Coal-Tar Creosote allows poles to retain their maximum strength, and helps to keep the poles at their best and hold the lines aloft.

IN THE SOUTH, prolonged high temperatures cause light-bodied preservatives to leach and evaporate from the wood rapidly, thus exposing the wood to termite attack and decay. Barrett Coal-Tar Creosote, heavier bodied and of lower volatility, prevents this condition. It stays in the wood longer under all conditions—doesn't "run out" on the job.

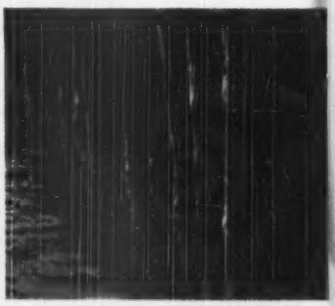


IN THE DESERT, crossties broom, shatter and split from extreme dryness and heat. Solutions made with Barrett Coal-Tar Creosote retard this, and also reduce mechanical wear of crossties through their lubricating action on the wood fibers. In poles, heavy treatment with Barrett Coal-Tar Creosote substantially reduces checking and splitting.

IN THE SWAMPS, forces of decay are almost at their maximum of destructive power. High moisture content and infection from other decaying wood and debris are ever-present menaces. Poles properly treated with Barrett Coal-Tar Creosote have survived under swamp conditions for years.



IN FRESH WATER, many preservatives leach out of wood. Barrett Coal-Tar Creosote resists this leaching action. Being only negligibly soluble in water, it is the preferred preservative for use on submerged wood structures, or those exposed to the powerful action of rapidly flowing water.



IN SALT WATER, marine wood-borers give a preservative its severest test. Of hundreds of preservatives that have been tried through the years, *Coal-Tar* Creosote is the only one that has proved consistently effective against teredos, limnoria and other salt-water enemies of wood.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

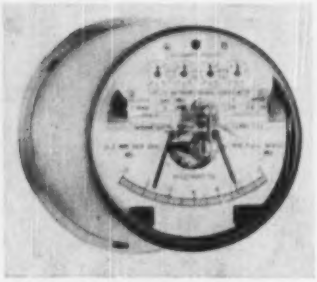
Only coal-tar creosote wood preservative has been used long enough and widely enough to have proved its effectiveness under all conditions.

Use Barrett*

*Reg. U. S. Pat. Off.

COAL TAR CREOSOTE

NEW EQUIPMENT



Watthour-Demand Meters

A COMPLETE LINE of combination watthour-thermal demand meters for 1-ph applications has been announced. Except for a small additional depth, these Type JT combination meters have the same dimensions as standard socket mounting or bottom-connected watthour meters; both these types are available.

Each meter element has separate current and potential coils so that measurements of energy and demand are performed independently. Meter capacities for normal loads not requiring CT's are 15 amp with full scale demand of 12 kw, and 50 amp with full scale of 24 kw. Full scale demand is 48 kw on meters rated 50 amp for use with heavy duty sockets. Full scale demand is based on 240 v. Five-amp capacities are available for use with current transformers.

Sangamo Electric Co, Springfield, Ill.

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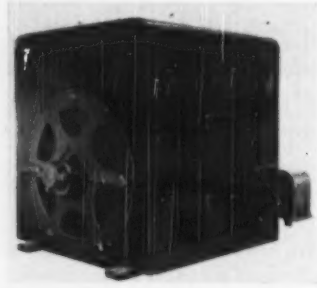

Large Motor Cooling

A FINNED TUBE air-to-air heat exchanger, formed from a single rectangular unit, is located at top of the welded-steel motor frame—comprising what is claimed to be a new idea for cooling large enclosed motors.

A fan draws cooling air from outside the motor, through the tubes, and out the front of the motor enclosure. Air within the motor is passed over the finned tubes, cooled, and recirculated.

For repair or replacement, the entire heat exchanger unit can be drawn out from the motor enclosure.

This type cooling can be applied to the company's 2-pole motors, 300 to 4,000 hp; and from 14-pole, 50-hp to 4-pole, 3,000-hp motors.

Elliott Co, Jeannette, Pa.

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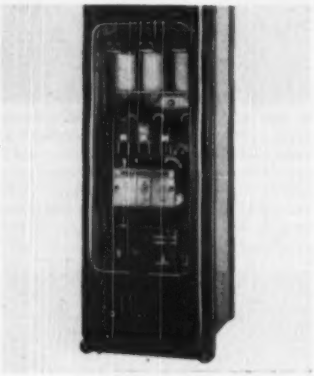
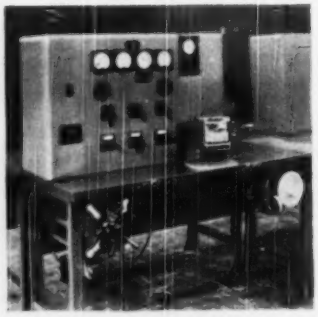


Distance Ground Relay

BASED on the same principle as the impedance relay used for phase protection, the Type HXS distance ground relay is designed to provide protection against the more common ground fault. Minimum length of line to which the relay can be applied must be long enough to produce at least 5 v zero sequence voltage drop on the relay when the fault exists at the balance point and minimum short-circuit current is flowing.

The relay measures the zero sequence voltage drop from relay to fault, and balances this voltage against the zero sequence current to give the zero sequence impedance. Reactance component of the impedance is measured. A phase selector relay is used to obtain proper phase-to-neutral voltage. Voltage of the faulted phase, properly compensated, is automatically applied by this relay to the single distance relay.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



Relay Test Set

SINGLE-PHASE power system relays and the 1-ph elements of polyphase relays can be tested with the Model SP-MBE relay test board. The board comprises the necessary supply, current, and potential transformers housed in a steel cabinet.

The ac current output circuit of the board has ranges of 1, 5, 10, 25, and 125 amp. The ac potential output circuit is metered with a voltmeter having ranges of 1.5, 7.5, 30, and 150 v. A phase-angle meter is provided for measuring electrical degrees between these current and potential circuits. One output circuit having a capacity of 3 amp at 6 v dc is provided with appropriate switchboard-type indicating ammeter and control on the panel. This dc source permits use of the conventional cycle-counter to indicate relay tripping time.

Instruments are the switchboard type, flush-mounted, with 270-deg scales accurate to 1%. The test board is supplied completely wired and calibrated so it may be connected to 120-v, 3-ph, 60-c supply.

Arthur E. Booth Co, 4125 Beverly Blvd, Los Angeles 4, Calif.

•

Running Board

LINE TWIST and kinking are reported to be eliminated by using swivel running boards. It is also said that torque usually present in the lead line on long

No. 2311 Autogap Fuse-Cutout. Brackets available for pole or arm mounting.

complete protection

. . . with No. 2311 Autogap fuse-cutout

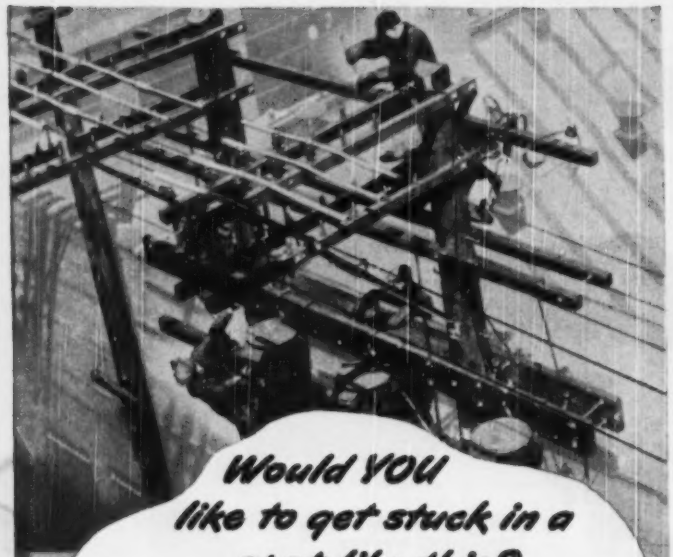
This combination of the No. 2302-9KV Hubbard Autogap Arrester with a 7½ KV flip-out type fuse holder offers these advantages: 1) Ready accessibility to all parts. 2) Ease in co-ordinating fuses with oil circuit breakers and sectionalizing equipment. 3) Maximum lightning protection. 4) Unit installation of lightning arrester and fuse cutout. 5) Time proven Autogap construction.

HUBBARD AND COMPANY

ESTABLISHED 1843

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the load on Hubbard Hardware!"



Would YOU like to get stuck in a spot like this?

Your linemen don't like to work on sticky, dirty poles and crossarms any better than you would. Of course, you must protect your poles and crossarms against rot and insects, but you can do it the *clean* way—the Penta Preservative way—at no extra cost and with positive knowledge that you're getting maximum protection.

You are sure with Penta because **penta**chlorophenol is a chemical entity, not a formulation or residue. It's exactly the same substance that it was 100 years ago; if it were different in any way it couldn't legally be called **penta**chlorophenol. Past performance records credited to Penta are based on the identical substance you buy today under that name.

Penta treated wood is clean, not sticky, not irritating to the skin. Your men will appreciate that fact. Yet it costs nothing to consider their feelings, because wood is treated with Penta in the same manner and with the same equipment as other accepted preservative materials, which themselves cost as much as Penta.

Add up the facts and see for yourself if it doesn't sound like a paying proposition. Just drop us a line and we'll be glad to send full information.

CHAPMAN CHEMICAL COMPANY

757 DERMON BUILDING • MEMPHIS 3, TENNESSEE

CHAPMAN

• IT'S CERTAIN • IT'S CLEAN • IT'S CERTAIN • IT'S CLEAN •

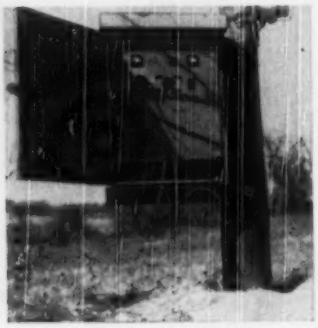
PENTA PRESERVATIVE

pulls is relieved with this device.

After the lead line is in position over the poles and the lineman has positioned the running board at the first pole, no further pole climbing is necessary. The swivels provide the strength to hold lines tight when working over live wires.

General Machine & Welding Works, 1100 E. Second St, Pomona, Calif.

•



Cathodic Protection

AMONG FEATURES of a new cathodic protection rectifier are the following:

1. Voltage adjustment by 8-step tap changer switch;
2. Inherent high inverse voltage protection (to 36 v);
3. Temperature and over-load protection;
4. Removable bug screens;
5. Heavy duty convection-cooled selenium rectifiers;
6. Terminals for external recording meter;
7. Indicating meters automatically disconnected except during readings.
8. Four sizes of rectifier panels fit one size of cabinet.

A heavy-duty insulating transformer suitable for operation on either 115 or 230 v is used to insure isolation of dc and ac circuits. Solderless connectors are used with ac and dc circuits. It is

MORE NEW EQUIPMENT

Just Received

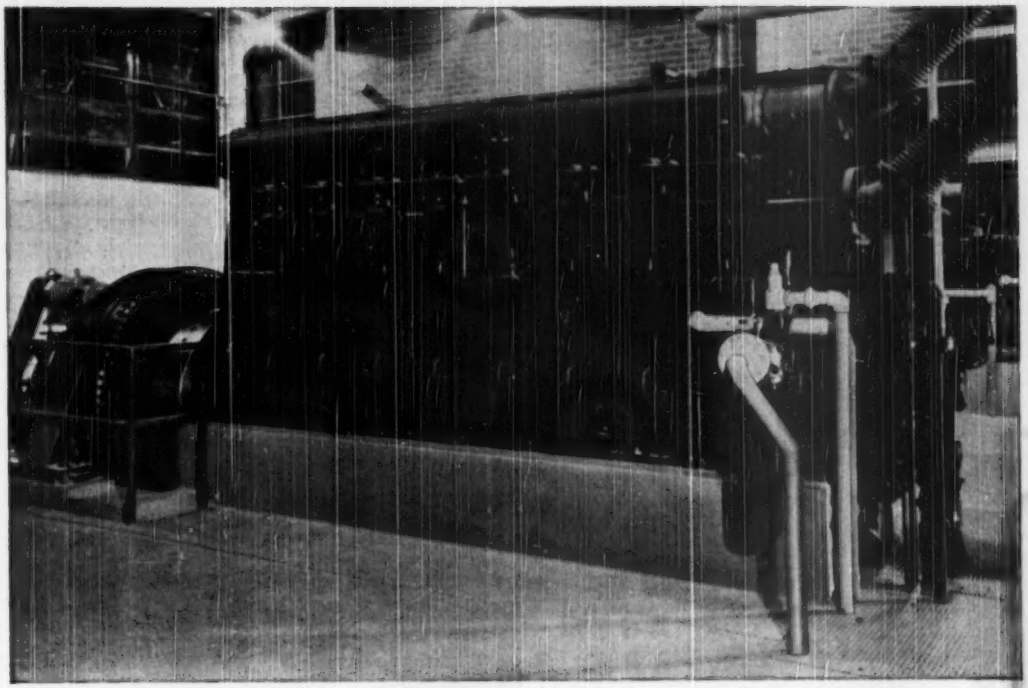
Appearing Next Issue

DISTRIBUTION TRANSFORMER
Has thermal CB, arresters, protective links in HV winding

HEAVY-DUTY CUTOUT
Designed to reduce recoil stresses, prevent arcs and flashover

HYDRAULIC BOOM
Rises to 40 ft, revolves in 270-deg arc, has dual controls

CT FIELD TEST SET
Checks for shorted turns, high R grounding, or tampering



IT'S RESULTS THAT COUNT

Three Model 60 Superior Diesels provide economy that results in important savings for a Michigan power company. Two of these engines are dual fuel units.

The economical operation of all three units resulted in the installation of a fourth Superior which combines both dual fuel and supercharging features.

Superior dual fuel design permits the use of oil, natural gas or combustible by-product gases with equal facility and efficiency. This cuts total fuel costs, and coupled with minimum fuel consumption per K. W., which is characteristic of Superiors, together with their dependable performance, gets results that count.

These same economical results can be yours with a Superior. Why not have one of our Superior representatives call and explain the many features Superior Diesel Engines have to offer. In the meantime, send for our free, fully illustrated booklet, *Superior Diesel For Stationary Applications.*

THE NATIONAL SUPPLY COMPANY
SUPERIOR ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio

THE NATIONAL SUPPLY COMPANY NSCO

Superior DIESELS

Locomotive · Marine · Oil Field · Stationary

FRICTION AND RUBBER
for premium quality at no extra cost*...
ACCURATE ASTM FRICTION TAPE
exceeds all requirements of ASTM designation: D69-48T
ACCURATE ASTM RUBBER TAPE
exceeds all requirements of ASTM designation: D119-48T

★ *ACCURATE Specification Tapes cost no more than ordinary ASTM tapes*

ACCURATE specification tapes do more than just meet ASTM specs—they exceed them by a good margin. This extra quality, however, does not mean a higher price. ACCURATE ASTM tape sells for the same price as competitive ASTM tapes. This is possible because ACCURATE Tapes are a product of the most advanced manufacturing methods, backed by the skill and experience of thirty years of specialization in tape manufacture.

Coast-to-coast warehouse stocks and sales representation for fast service everywhere

Write today for the name of the ACCURATE Tape representative nearest you, and for your copy of the new 6-page illustrated folder just off the press. Address inquiries to ACCURATE MANUFACTURING CO., GARFIELD, N. J.

ACCURATE TAPE

said that one man can remove the panel for maintenance or change to a unit with higher or lower rating.

The all-weather cabinet is welded steel construction. There are protected openings at top and bottom of the cabinet for convection cooling purposes. Bulletins JA-3 and JR-4 contain additional details.

Control Corp, 718 Central Ave, Minneapolis 14, Minn.

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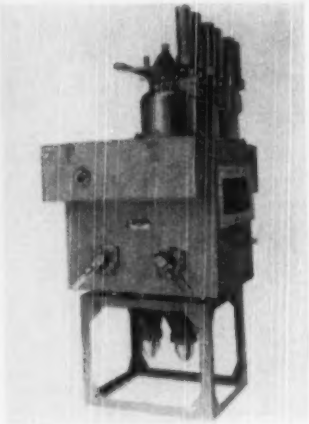


Cable Sectionalizer

FUSE PROTECTION can be provided for a load that can be fed from either of two feeders by use of an addition to the company's cable sectionalizing equipment. The device combines a load break oil switch with a set of three gang-operated oil fuse cutouts. The cutouts permit isolation of load without interrupting loop circuit continuity. Either feeder can be isolated and grounded without disturbing service on the other.

The switch mechanism and cutout connections are enclosed in a welded steel, oil-filled tank. The tank can be constructed for direct attachment to transformers or for individual installation in any subway or exposed location.

Standard units are furnished with cutouts rated 2,500, 5,000 and 8,000 v, and 400-amp load break switches rated at 7,500 or 15,000 v.

G&W Electric Specialty Co, 7780 Dante Ave, Chicago 19, Ill.

•

Illumination Recorder

ACCURATE measurement and recording, at 10 to 20 mph, of varying amounts of light along roads is claimed for the Rapid Recorder for measuring street illumination. The record, company engineers state, is so simple that municipal officials will more quickly grasp the meaning of the study and see the need

YOU CAN BE SURE.. IF IT'S
Westinghouse

A New 100-AMPERE Type GR Recloser...

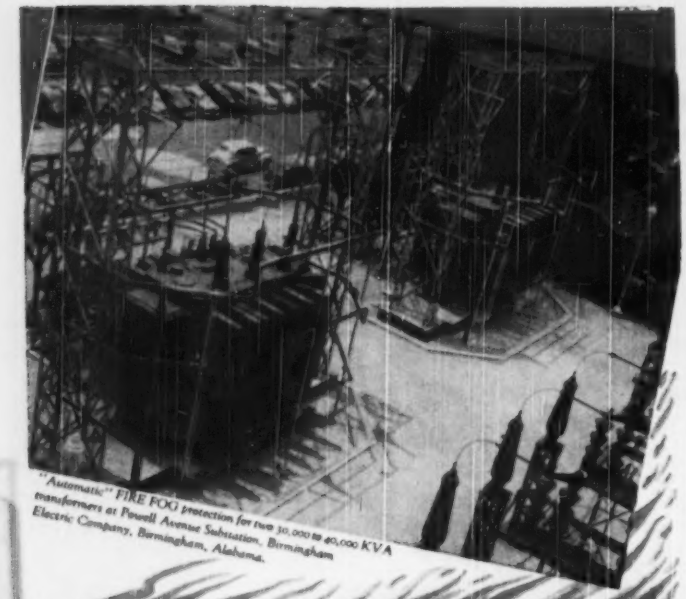
For Rural and Suburban Distribution

- 100 amperes—continuous current rating
- 2,000-2,500 amperes—interrupting rating
- Full 15-kv insulation (110-kv impulse withstand)
- Interrupts 2,000 amperes with full 15 kv across one pole
- Heavy top casting and deep-drawn tank—both heavily hot-dip galvanized
- *One* fast, and *three* time-delay openings, or *four* time-delay openings
- Bushings, mechanism, hangers—all interchangeable with 50-ampere series
- Five coil sizes available—25, 35, 50, 70, 100

The 100-ampere GR Recloser is available for immediate delivery now. Use it to provide complete, economical protection for your rural *and suburban* lines. For complete information, ask your Westinghouse representative or distributor for Bulletin B-4339, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60721

WESTINGHOUSE

GR RECLOSERS



"Automatic" FIRE FOG protection for two 30,000 to 40,000 KVA transformers at Powell Avenue Substation, Birmingham Electric Company, Birmingham, Alabama.

Ready, Willing and Able
TO COMBAT ELECTRICAL EQUIPMENT FIRES

Only a hint of flame at this bank of high voltage transformers and—quick as a flash, *Automatic* FIRE-FOG goes into action. From strategically positioned nozzles, a concentration of fine water spray is directed at the blaze. Flames are forced down . . . the fire area cooled. In but a matter of seconds, extinguishment is complete and damage to equipment confined only to the point of fire origin. Even out-of-service time has been held to a minimum.

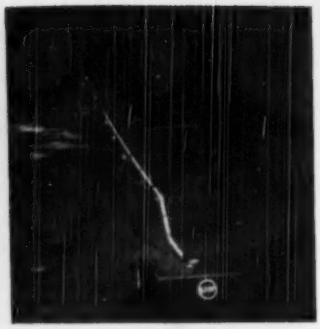
. . . a famous member of the *"Automatic Sprinkler"* Family . . . provides basic fire protection for process equipment and storage in the chemical and petroleum industries. On-the-spot protection for quench tanks, dryers, explosive hazards, conveyor openings, air filters, oil filled electrical equipment and other units vital to production line operations.

Although a relatively new development, *Automatic* FIRE-FOG is widely recognized by both utility companies and private users. Designed specifically for your particular risk it is electrically safe and carries the approval of all leading insurance authorities.

More detailed information, especially as to how *Automatic* FIRE-FOG can serve your needs is available upon request and surveys and estimates will be furnished without cost or obligation. Write today.

"AUTOMATIC" SPRINKLER CORP. OF AMERICA
YOUNGSTOWN 1, OHIO

"Automatic" Sprinkler
FIRST IN FIRE PROTECTION
DEVELOPMENT • ENGINEERING MANUFACTURE • INSTALLATION
OFFICES IN PRINCIPAL CITIES OF NORTH AND SOUTH AMERICA



for better street lighting.

The device consists of an "electric eye on wheels", connected by a 30-ft aluminum tube to an automobile carrying an amplifier and graphic recorder. The light-sensitive "eye", riding only 6 in. above pavement level, trails far enough behind the auto to permit its having an unobstructed view of the highway lighting.

Among advantages seen for this equipment are: Its use as a "yard stick" for correlating night accident experience with existing illumination; determination of adequacy of lighting layouts; and assisting lighting equipment makers in checking their laboratory photometry against actual field results.

General Electric Co, Lamp Dept, Nela Park, Cleveland 12, Ohio

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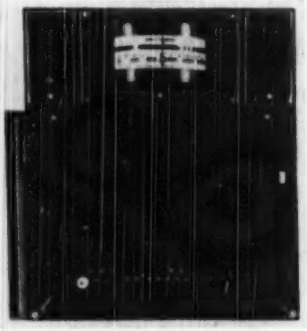


Instrument Line

A NEW LINE of instruments known as the Cabinet Series has been designed to incorporate auxiliary equipment into the case of a direct-reading electronic controller. Contained in a dust and tamper-proof housing and operating with the Electronic Link, these instruments are used for measurement, indicating and automatic control of voltage, current, temperature, speed, flow, pressure, etc.

By combining equipment to secure a centralized control system, the need for extra instrument panels or housings

ADVERTISEMENT

NOCRETE WITHOUT CONCRETE ENCASEMENT

Orangeburg Fibre

STANDARD WITH CONCRETE ENCASEMENT

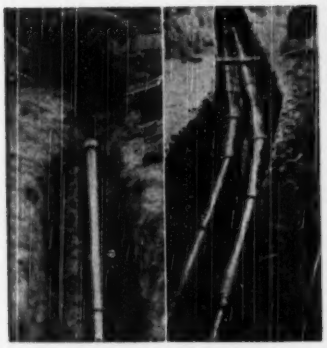
CONDUIT NEWS

MORE BUSINESS — MORE PROFITS FOR THE CONTRACTOR

VOL. 1 NO. 2 JULY 1950 ★★★★★

LEADER AND FIRST CHOICE IN EVERY CITY AND STATE!

NOCRETE for One and Two Duct Installations

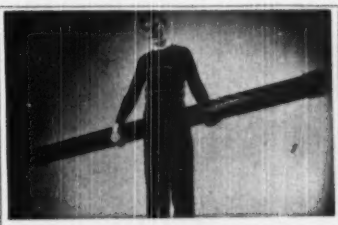


For single or double duct runs, ORANGEBURG NOCRETE (Type 2) is the *ideal* conduit. Made with heavier walls for installations *without* concrete encasement, *Nocrete* makes possible valuable savings on such installations as — factories, schools, colleges, hospitals, drive-in theatres, power, telephone and other communications systems — also service entrance, parkway and suburban lighting, airport lighting and communication.

NOW BRANDED WITH ORANGEBURG TRADEMARK

DISTRIBUTED BY

Graybar ELECTRIC COMPANY



LIGHT, EASY TO HANDLE

. . . and *more workable*. That's why Orangeburg Fibre Conduit is a big help in lowering transportation costs and speeding installation.

CUT AND WORKED ON JOB

Orangeburg can be cut with rough tooth hand saw — drilled or worked with ordinary hand-working tools.

Time Defying Materials

Unretouched photograph of Orangeburg material removed from ground after 41 years. Orangeburg withstands ground waters, acids, oils and alkalies.

MORE ORANGEBURG AVAILABLE

. . . at *more distribution* points through Graybar Electric Company and General Electric Supply Corporation.

ORANGEBURG KEEPS FORGING AHEAD

North, south, east and west Orangeburg Fibre Conduit is the first choice of leading utilities and municipalities, many contractors and practically all design engineers. Orangeburg innovated all the important advancements of the fibre conduit industry — another reason why it's the leader.

When the installation requires duct-banks of four or more ducts, ORANGEBURG STANDARD (Type 1) — installed *with* concrete encasement — is the *preferred* conduit.

JUST A TAP OR TWO

Tapered Sleeve Couplings save a lot of time for the Contractor. A few light taps on the coupling drive it firmly against the shoulder of the conduit. This makes a permanently tight, infiltration-proof joint.

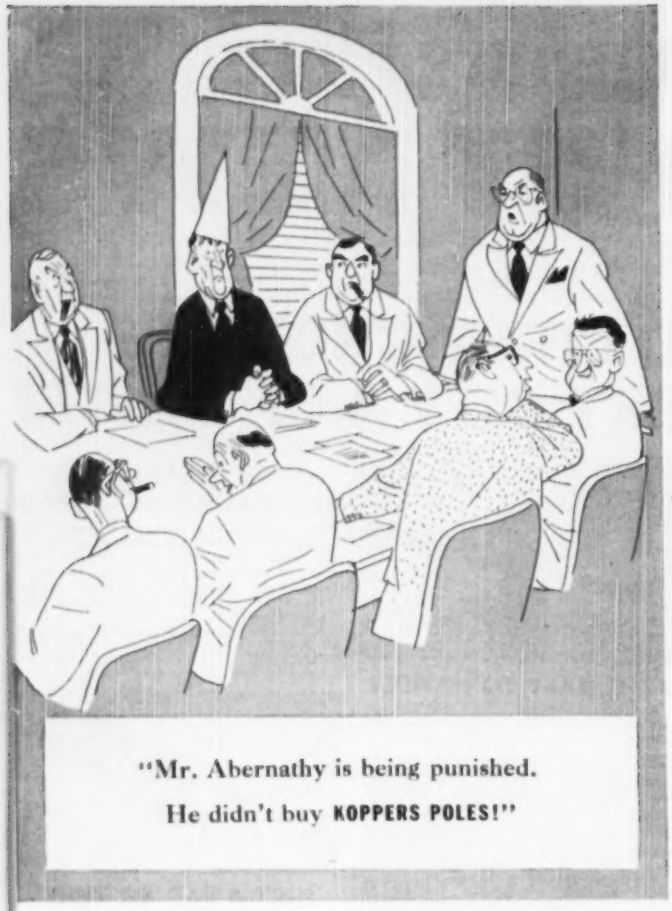
Send for Bend Section Folder

Conduit-line transformation problems like this are greatly simplified by Orangeburg Bend Sections. Illustrated folder — showing various types of Orangeburg Bend Sections and Angle Couplings, their specifications, advantages and applications — sent FREE on request. Write today to Dept. EW-7, Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

DISTRIBUTED BY

GENERAL ELECTRIC SUPPLY CORPORATION

ORANGEBURG MANUFACTURING CO., INC., ORANGEBURG, NEW YORK



● Literally *millions of poles* have been pressure-treated by Koppers . . . have been fully protected against decay—the greatest threat to the strength and serviceability of wood.

Koppers Treating Process is modern and scientific. Under controlled pressure, creosote is forced deeply into the wood *for the full length of the pole.* This thorough impregnation is possible only in large treating cylinders such as Koppers uses. And, of course, Koppers makes certain that only sound, properly-seasoned wood reaches the treating stage.

To get maximum pole service, many experienced buyers order from Koppers. Write us for a quotation.

KOPPERS COMPANY, INC. **PITTSBURGH 19, PA.**

KOPPERS

Koppers Full-Length Pressure-Creosoted Poles are available in ample quantities from many conveniently-located treating plants.

PRESSURE-CREOSOTED WOOD

for auxiliary equipment is said to be eliminated. Bulletin CAB-1 contains further information.

Wheelco Instruments Co, 847 W. Harrison St, Chicago 7, Ill.

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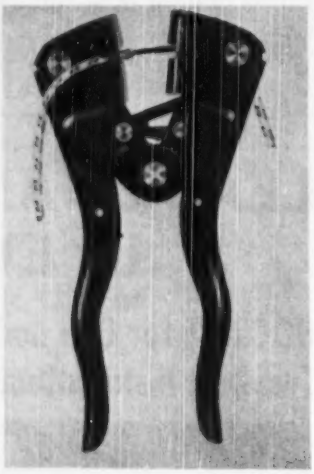

WIRE STRIPPERS—Automatic grip release and replaceable milled cutters are features of a new wire stripper. Blade No. 128 strips wire up to 5/16 in. O.D., Awg No. 12 and smaller. Blade Model 140 has a four-hole blade for up to 1/4-in. O.D., Awg No. 14 and smaller.

Rockford Wire Stripping Co, Cutler Bldg, Rockford, Ill.

•

AC Arc Welders

SETTING welding current for a new line of transformer-type ac arc welders is accomplished without cranking. Control of the five main taps of welding current from low to maximum is performed with a handwheel switch. By using the rheostat to control amount of dc flowing into the reactor, approximately 500 different welding current

—of a Kidde Dry Chemical Fire Extinguisher

Pound for pound, *Kidde* Dry Chemical Fire Extinguishers give you more *protection* for fires in flammable liquids, live electrical equipment and for textiles.

Proof? Factory Mutual Laboratories requires a 20 lb. dry chemical fire extinguisher, in the hands of an experienced operator, to effectively cover 25 square feet of burning area. *The Kidde 20 pounder covered 36 square feet . . a 44% margin of safety!* And—the tests require a 30 pounder to cover 35 square feet . . . *but Kidde's Dry Chemical extinguisher reached out 48 square feet!*

Why is Kidde better? A special Diffuser Horn applies heat-absorbing, fire-smothering dry chemical in an effective cloudlike pattern that blankets the danger area, helps eliminate splashing of burning liquids, and protects the operator from heat.

Ruggedly built, simply constructed, quick to recharge and equipped with easy-to-operate Trigger Finger Control, *Kidde* Dry Chemical Extinguishers mean sure death to fire—and extra safety for you.

Kidde Dry Chemical Extinguishers can be used in normal standing position, just pick unit up, point the horn, pull the trigger.

Streamlined diffuser horn gives better discharge pattern, means greater coverage, insulating blanket for the operator.

Kidde

Walter Kidde & Company, Inc., 730 Main Street, Belleville 9, N. J.
In Canada: Walter Kidde & Company, Ltd., Montreal, P. Q.

WHEN Time IS
THE ESSENCE
in Line Clearance
YOU'LL FIND BARTLETT READY
THAT'S one of the benefits in dealing with Bartlett . . . adequate man power, men who are thoroughly trained, not just picked up for a few days' work. When you deal with Bartlett, you're dealing with a company that's on the job every week, every month of the year, ready at all times to do your work when you need it, and do it the right way.
MORE and more utility companies are turning to Bartlett every year; they've found out that the plus value in every Bartlett job is just plain good business. Why not benefit, too? Call our local office in your community today.
BARTLETT SERVICE MEANS
• CLOSE SUPERVISION
• TRAINED MEN
• BEST EQUIPMENT
• CAREFUL WORK
• PROMPT SERVICE
• ECONOMY
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settings are available without changing either electrode or ground cable connections.

Model TSP-205-C with power factor correction is rated 200 amp, at 30 v. Model TSP-182-C with power factor correction and limited input for operation on REA lines is rated 180 amp at 25 v.

Hobart Brothers Co, Hobart Sq, Troy, Ohio

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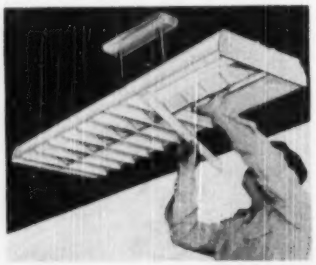

Removable-Louver Fixture

COMMERCIAL-TYPE fluorescent lighting fixtures are equipped with metal cross louvers held in place by a spring locking device. They can be removed individually for cleaning and maintenance work.

The series involves 2 or 4 fluorescent lamps in 48-in. and 96-in. lengths. The fixtures can be suspension or flush ceiling mounted, and can be used individually or joined end to end to give the effect of continuous louvering. Louver shielding is 35 deg crosswise and 25 deg lengthwise to the lamps. Bulletin No. 465 describes this Luv-R-Lok series.

Lighting Products, Inc, Highland Park, Ill.

MORE NEW PRODUCTS
about which you should know

E. F. DREW & CO. INC, POWER CHEMICALS DIV, NEW YORK, N.Y., has developed a total **alkalinity indicator** end point of which occurs at the same pH as methyl orange, but it is said to give a clearer and more distinct end point. . . . . A. O. SMITH CORP, KANKAKEE, ILL., has designed an adjustable element by which any of three volumes of water is heated in a new automatic electric home **water heater.** In addition to the change of position, this element may be set for wattages of 1,000, 2,000 or 3,000, depending on terminal connections.

ALBRIGHT MFG CO, 9607 WHITCOMB, DETROIT 27 MICH., is offering the Arctic **pipe thawing transformer** rated at 1½

kva for ½ to 1½ or 2-in. pipe in lengths from 20 to 60 or 70 ft. . . . Lepel High Frequency Laboratories, Inc, New York, N.Y. has announced a combination **work table and quench tank** for its high frequency vacuum tube or spark gap converters. It will also accommodate the company's heating and quenching unit for hardening gears, blanks, etc.

John I. Paulding, Inc, New Bedford, Mass., is making a duplex surface **outlet** with large headed terminal screws and two double-spring phosphor-bronze clips to provide positive contact. . . . Edwin L. Wiegand Co, 7500 Thomas Blvd, Pittsburgh 8, Pa., is producing a high-speed electric **range unit** to be known as the Chromalox Rocket; rating is 1,600 w with an 850-w hot spot inner coil.

Union Carbide & Carbon Corp, Bakelite Div, 122 E. 42nd St, New York 17, N. Y., is making refrigeration **power supply cords**, No. 18 or 16 Awg, of Vinylite plastic insulating compound.

Plastic Engineering & Sales Corp, P. O. Box 1037, Fort Worth, Tex., has announced Bauer & Black's Polyken tape as a complete **pipe coating**; average coating resistance after backfill is reportedly over one million ohms per sq ft. . . . Steber Mfg Co, Broadview, Ill., is producing the Utilite line of **lampholders**; socket can be adjusted 360 deg horizontally and 180 deg vertically. Complete information in Bulletin 121-50.

Farrelloy Co, 1233 N. 26th St, Philadelphia 21, Pa., has introduced an all-metal **solder**, said to show high resistance to corrosion, for use with stainless, Iconel, and Monel metals. . . . Frazier & Son, 38 Cortlandt S9, Belleville, N. J., has the Fra-Sure variable speed **transmissions** for fractional hp motors, can be set with a knob.

Wheelco Instruments Co, 847 W. Harrison St, Chicago 7, Ill., has developed a portable direct-reading indicator for determining **ratio of lead and tin** content in solder; said to be useable in a matter of seconds. . . . Brooklyn Varnish Mfg Co, 50 Jay St, Brooklyn 1, N.Y., is manufacturing a **primer** for rusted metal called Tuf-On-Rust. It is recommeded for use in plant maintenance, or iron and steel construction work.

Lyon-Raymond Corp, 14469 Madison St, Grene, N. Y., has announced an electric **tiering truck** with forks elevating to 130 in. . . . Sepco Corp, Pottstown, Pa., has introduced **stone-lined tanks** which are said to offer increased protection against electric water heater tank corrosion.

HEVI DUTY TRANSFORMERS
. . . engineered to do a specific job!

500 KVA
Primary 2600/5200 volts

Here is a typical solution to a "short circuit testing" problem

This transformer, designed to take the stresses involved in short circuit testing of electrical equipment, is an example of the many special problems which Hevi Duty engineers have solved.

Whether you require a transformer designed to suit your particular needs, or standard lighting and power transformers, Hevi Duty equipment is engineered and constructed to do that specific job.

Write for Bulletin HD 499.

HEVI DUTY ELECTRIC COMPANY
HEAT TREATING FURNACES HEVI-DUTY ELECTRIC EXCLUSIVELY
DRY TYPE TRANSFORMERS — CONSTANT CURRENT REGULATORS
MILWAUKEE 1, WISCONSIN

NEWS ABOUT PEOPLE

Busey, O'Brien Named Vice Presidents at GE; Pritchard Heads Supply Firm

John L. Busey has been elected a vice president of the General Electric Co in charge of marketing policy, a newly created post. He had been president and a director of General Electric Supply Corp.

William V. O'Brien, formerly general sales manager of GE's apparatus department, has been appointed a commercial vice president and will be assistant manager of marketing policy for the company.

Succeeding Busey as president and director of General Electric Supply Corp is Charles R. Pritchard. Until his promotion, Pritchard served as manager of marketing for GE's appliance and merchandise department.

Started as Salesman

Busey entered the electric industry in 1909 as a salesman for the Capitol Electric Co of Salt Lake City, a GE distributor which later became part of the General Electric Supply Corp. In 1919 he became manager of the Butte (Mont.) Electric Supply Co, and six years later transferred to the San Francisco office of the Pacific States Electric Co, a GE distributor. The following year, he became assistant to the president in charge of sales for Pacific.

In 1929 Busey was made district manager of the GE Supply Corp in Boston and in 1932 transferred to Bridgeport as general sales manager. Later he joined GE as manager of appliance sales for the merchandise department and in 1935 became president of the supply company.

Headed Wholesalers Association

Busey is a past president of the National Electric Wholesalers Association.

O'Brien has been associated with GE since 1922 when he joined the company's test course for student engineers. From 1924 until 1937 he served in several sales engineering capacities in the company's Southeastern District. He then returned to Schenectady as a proposition engineer in the Central Station Division. He was named assistant to the manager of the Lighting and Cable Division in 1938, manager of the Wire and Cable Division in 1940, and assistant manager of the Central Station Divisions in 1945.

In 1947 O'Brien was appointed assistant manager of sales for the apparatus department and became general sales manager in 1948.

Pritchard started with GE in 1918 as a clerk in the Birmingham office. From 1920 to 1932 he was with Matthews Electric Supply Co, Birmingham, a GE distributor, becoming merchandise manager. In 1932 he joined General Electric Supply Corp at Atlanta as promotion manager and became appliance sales manager in 1934.

Moving to Bridgeport in 1937, Pritchard became manager of specialty appliance sales for GE Supply Corp and later was named vice president. In 1944 he was appointed general sales manager of the GE appliance and merchandise department and three years later was named manager of marketing for the department.

•

Henninger to Join Staff of Iowa State College

G. Ross Henninger, director of publications for the Illuminating Engineering Society, will join the Iowa State College Engineering Extension Service staff on Sept 1. His new duties will include editorial work and instruction.

Before joining IES in 1948, Henninger was a member of the headquarters staff of the American Institute of Electrical Engineers in New York. From 1930 to 1933 he was associate editor of AIEE's *Electrical Engineering*, and in 1933 he became editor.

Henninger entered the editorial field in 1924 as engineering editor of the *Journal of Electricity*, which subsequently became *Electrical West*, a McGraw-Hill publication. Prior to that he worked as utility engineer with the Southern California Edison Co, Los Angeles.

Henninger served as a civilian consultant to the Secretary of the Navy in 1942. He was later commissioned a lieutenant colonel in the Army, serving as a technical publications officer at Wright Field.

Vepco Names E. H. Will Operating Vice President

Erwin H. Will has been elected vice president in charge of operations of Virginia Electric & Power Co. At the same time Montelle C. Smith, a vice president since 1936, was named vice president and general manager.

Will started with Vepco, then Virginia Railway & Power Co, in the engineering department in 1922. Later he was transferred to the Norfolk properties in charge of the engineering department and then became assistant superintendent of the electric department. He was appointed manager of the Suffolk district in 1928.

ERWIN H. WILL

From 1935 to 1947 Will served as president of El Paso (Texas) Electric Co. He returned to Vepco in 1947 as general manager of operations.

Smith, a veteran of nearly 50 years in the public utility business, joined the Stone & Webster organization as a student with Cape Breton Electric Co, Ltd, at Sydney, Nova Scotia. There he served as purchasing agent, assistant to operating executive, and superintendent of light and power.

Later he managed the Brockton & Plymouth Street Railway Co and did electrical engineering work with the Lowell organization. He spent two years with Nova Scotia Tramway & Power Co at Halifax as superintendent of the light and power department and then supervising the tramway department. In 1923 he returned to Sydney as manager.

Smith was made president of Baton Rouge (La.) Electric Co in 1926 and

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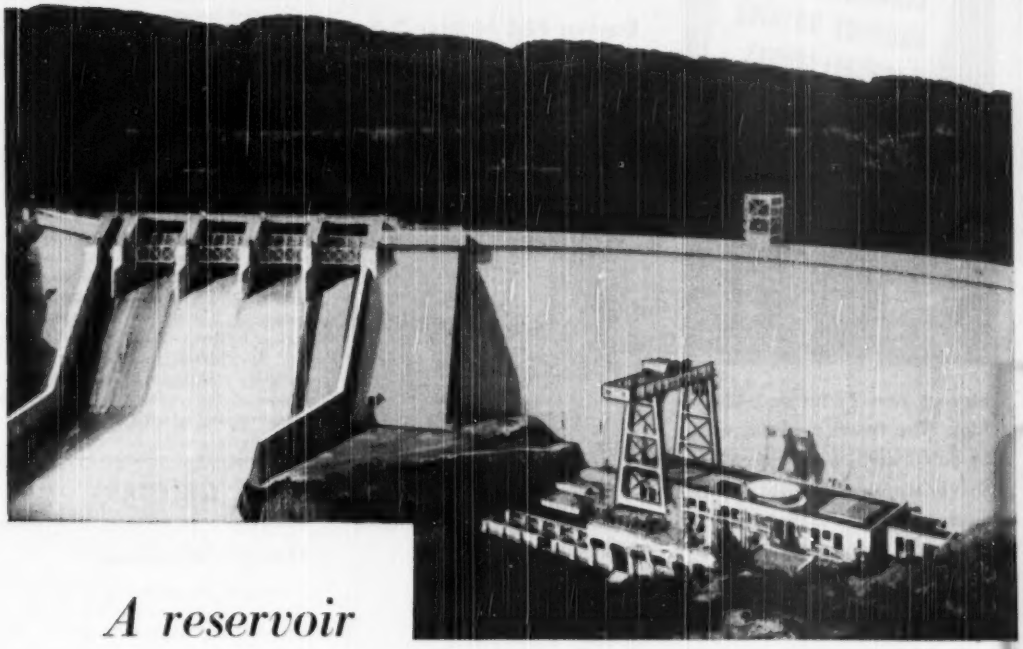

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This arch dam towering 315 feet above bedrock and the adjacent power station were engineered and constructed by EBASCO for the Pacific Power & Light Company.

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A semi-outdoor installation—a type in which EBASCO has pioneered—Merwin embodies the latest in hydro-electric facilities. It is one of four hydro projects designed and built by EBASCO in the State of Washington.

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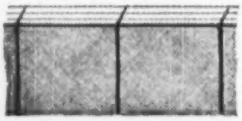

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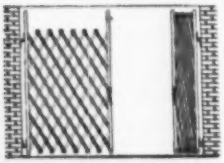

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Stewart IRON and WIRE FENCES

president of El Paso Electric in 1931. Five years later he went to Vepco as vice president.

•

Dayton P&L Names Oxley Electric Operations Head

Kenneth G. Oxley has been appointed manager of electrical operations for Dayton Power & Light Co. He has been assistant to the manager.

Oxley joined the company in 1940 as a project engineer and later became assistant superintendent of the line department. Before going to Dayton P&L, Oxley worked for National Gas Pipe Line Co, United Light & Power Service Co, and Iowa Electric Light & Power Co.

KENNETH G. OXLEY

•

Wisconsin Legislator Heads Dairyland Co-op

Wisconsin State Sen John E. Olson has been elected president of Dairyland Power Cooperative, the world's largest generation and transmission co-op. He succeeds the late E. J. Stoneman who served as president since Dairyland was organized in 1941.

Olson has served on the board of directors since the cooperative was formed. He is secretary of the Wisconsin Electric Cooperative and was president of the Barron County Electric Cooperative until his election last year.

•

Thomas Sproule, production manager of the Fitchburg Works of General Electric Co's Welding Division since 1948, has been appointed assistant manager of manufacturing for the Fitchburg Turbine and Welding Divisions. Sproule joined the company in 1937 in the general office accounting section and later worked at the Erie Works and with the production section of the Apparatus Department.

Ralph D. Stauffer, vice president, director, and chief engineer of New England Gas & Electric Association, Cambridge, has been elected president of the Massachusetts Society of Professional Engineers. **Roy E. Argersinger,** vice president and consulting engineer, Stone & Webster Engineering Corp, was named vice president.

H. Dudley Swim has been elected chairman of the board of The Baker-Raulang Co, maker of industrial trucks. **Clarence M. Taylor** was named chairman of the executive committee and **John R. Morrill** vice president in charge of sales. Swim became a director in 1948. He has been associated with the transportation industry for several years. Taylor is a former executive vice president of Lincoln Electric Co, and Morrill has been assistant to that company's vice president in charge of public relations, sales promotion, dealer relations, and advertising.

OBITUARY

Henry I. Harriman

Henry I. Harriman, 77, co-founder of New England Power Co, now a part of the New England Electric System, died at Needham, Mass., on July 4 following an extended illness.

HENRY I. HARRIMAN

Active in the utility industry for many years, Harriman retired as president of New England Power in 1929 because of the pressure of public duties. His career in the utility field began when he and Malcolm G. Chace visited the South on a business trip and became interested in water power development on the French Broad River. They organized the Southern Hydro-Electric Co.

After selling his Southern interests, Harriman returned to New England and formed the Connecticut River Power Co

of New Hampshire in 1907. The company built the first hydroelectric plant of the system at Vernon, Vt. After long hearings Harriman received permission from Massachusetts Public Utilities Commission to sell power in substantial blocks to central Bay State communities. Over the years the system grew to become the largest New England power utility group, with total consolidated assets of $487,076,000.

At the time of his death, Harriman was vice chairman of the board of the New England Power Association.

Harriman was born in Brooklyn in 1872. He held degrees from Wesleyan University and New York Law School. Before entering the utility business, Harriman was associated with the textile industry and patented several inventions for automatic looms.

Among his public positions, Harriman served as president of the United States Chamber of Commerce and the Boston Chamber of Commerce, as trustee of the Boston Elevated Railway, and as employers' representative of the United States at the International Labor Conference in Geneva.

•

Dr Trygve D. Yensen, 68, authority on the science of magnetics, died July 2 at Prestwick, Scotland. He had retired June 30 from Westinghouse Research Laboratories. He was on his way to his native Norway when he was stricken. Yensen joined Westinghouse in 1916 and at the time of his retirement was manager of the Magnetics Department.

William C. Yates, 72, who retired in 1946 as assistant manager of General Electric's industrial control department, died June 23 in Schenectady, N. Y. Yates joined the testing department in 1898 and eight years later was named industrial control specialist in its New York office. He returned to Schenectady in 1913 as commercial engineer in the industrial control department.

Herbert M. Edmonds, 61, division manager of the California Oregon Power Co. Dunsmuir, Calif., since 1921, died June 14. A native of Michigan, he started with the power company in Yreka, and served with the firm in Roseburg, Ore., and Kalispell, Mont.

Walter J. Clark, former superintendent of power, electrical maintenance engineering, and communication at General Electric's Pittsfield, Mass., works, died recently in that city. He joined the company in 1912.

Charles L. Geiger, former Galion, Ohio, service director and superintendent of the municipal light and power department, died June 26.

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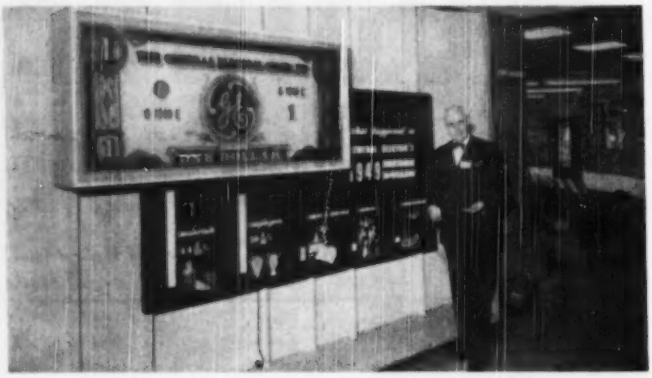

VISITORS to General Electric Co's Lighting Institute at Nela Park will get an illuminated explanation of what GE does with its dollars. The GE exhibit dollar is divided into five sections showing that 44.5% of it goes for materials, 39.8% for employees' wages, 8% for taxes and interest, 4.4% for return to investors, and 3.3% for reinvestment. L. C. Kent, dean of the institute, holds coins to indicate relative shares of workers and owners

Allis-Chalmers, UAW Sign 5-Year Pact Covering 10,000 at Milwaukee Plant

Allis-Chalmers Manufacturing Co and Local 248, UAW-CIO have signed a five-year contract covering 10,000 production employees at the West Allis plant in Milwaukee. It provides for wage increases and includes a modified no-strike pledge. The contract is subject to ratification by the union members.

The agreement grants workers a 3¢ hourly wage increase effective immediately and another 3¢ at the beginning of the second year of the contract. At the end of the second year wage negotiations may be reopened or the parties may continue the 3¢ per hour raise for each of the three remaining years.

The contract also provides for adjustment of the hourly rate in accordance with changes in the cost of living index of the Bureau of Labor Statistics. The adjustment agreed upon is 1¢ for each 1.25 change in the index.

Under the terms of the contract, the union agrees to prohibit strikes except following a strike referendum during the wage reopening period at the end of two years.

A modified union shop is provided in the contract. Employees who were not union members at the signing of the contract are not required to join and present members of the union may resign during a five-day period after the contract goes into effect. All new employees must join the union within 90 days after they are hired. They are required to pay the initiation fee, union dues and general assessments as a condition of employment.

Other provisions of the contract include an increase in the group insurance minimum from $2,000 to $3,000 with the premium reduced from 60¢ per $1,000 per month to 45¢, an amended vacation plan, and improved grievance machinery.

Allis-Chalmers workers retiring at the age of 65 with 25 years of service will receive $100 per month maximum pensions, including federal social security benefits. The pension plan had been worked out previously between the union and the company and is in effect in four other plants.

Contract negotiations are being conducted by the company and the union at plants in La Crosse, Wis.; Springfield, Ill.; Pittsburgh, Pa.; and Gadsen, Ala.

GE Appliance Sales Up; Home Building Credited

The nation's home building boom has been given credit for playing an important part in the high level of General Electric Co appliance sales in the first half of 1950. Such sales were 20% higher than in 1949. First and second quarter sales ran at about the same level. A continuation is expected for the third quarter and a slight increase is expected for the fourth because of Christmas demands for traffic appliances.

H. L. Andrews, vice president in charge of the Appliance and Merchandise Department, reports that speculative builders and real estate developers in increasing numbers are installing complete electric kitchens and laundries in homes they have for sale. "Many thousands of GE major appliances and cabinets are going into this market." The volume of this business is greater than ever before.

"One exceptionally large order from a Western builder," Andrews said, "was for 2,000 complete GE kitchens—each incorporating a refrigerator, range, dishwasher, garbage disposer, automatic washer, and cabinets. Many orders are received for 100 or more complete kitchens."

•

Foreign Manufacturers Get 2nd Chance at Seattle

Bids for another large electrical equipment contract, expected to interest foreign manufacturers, have been called by Seattle City Light for opening Aug 16.

The new contract involves six 40,000-kw transformers, estimated to cost about $200,000, for a substation. Bids previously had been called, for opening Aug 15, for governors and butterfly valves for the Ross power plant.

The transformer specifications contain no bar against foreign bids, said Paul R. Hendricks, city purchasing agent, but stipulate that the equipment must have American standard threads and General Electric Co bushings or insulators, or bushings that are interchangeable with General Electric. They also require a 100% performance bond.

City Light found itself the center of

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Interlocked or automatic throw-over. Draw-out or stationary types. Magnetic trip, or thermal, or combination. All incorporated with high quality, liberally designed

Sorgel Air-Cooled Transformers

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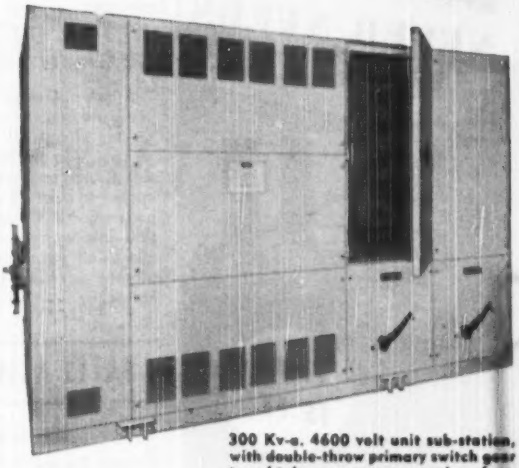
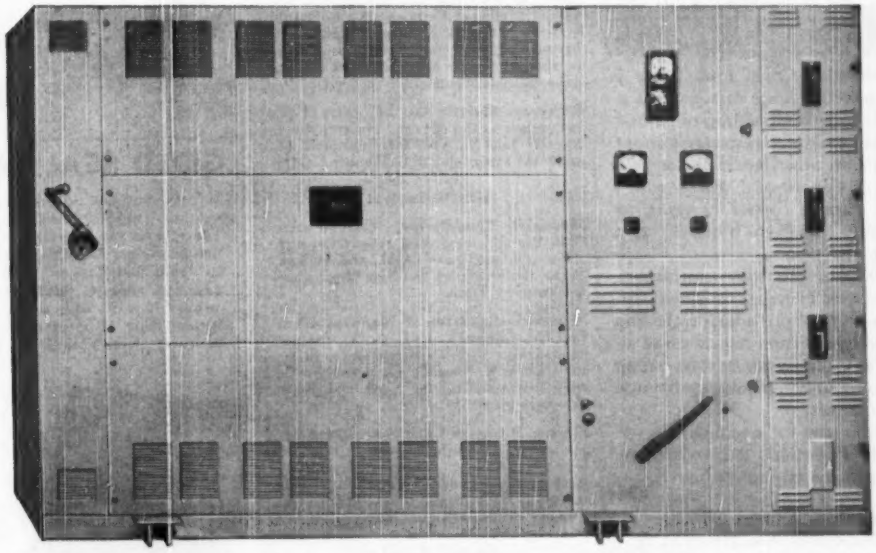
Sizes up to 2000 Kv-a. All voltages up to 15 KV.



300 Kv-a. 4600 volt unit sub-station, with double-throw primary switch gear to obtain emergency service from more than one source. Secondary main and tie breakers interlocked to obtain secondary service through another unit. Thermal type branch circuit breakers.

Send for new bulletin 450



1500 Kv-a. 13,200 volt unit, with primary disconnect, secondary metering, main and branch circuit breakers.

Sales Engineers in Principal Cities

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Because of its unique construction, Copperweld Fence is rust-proof, corrosion-proof. It provides long lasting property protection regardless of atmospheric conditions. It stays strong and in alignment. It costs less because it lasts longer.

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*Trade Mark

COPPERWELD STEEL COMPANY
1025 Monongahela Ave., Glassport, Pa

an international controversy earlier this year when it rejected lower British bids for three larger transformers as not meeting specifications and gave the contract to a United States firm. These same British firms have indicated they will bid again, as have Swiss and French concerns.

•

GE Grants 3% Pay Boost

A general wage increase of 3% is being put into effect by General Electric Co for almost all of its 160,000 employees. The pay boost, with 4¢ an hour as the minimum, begins this month and applies to most all workers except company officers. GE emphasized, however, that the increase would be put into effect only where union leaders of employees in bargaining units do not object.

SALES ASSIGNMENTS

COMPANY STAFFS

General Electric Co's Lamp Department has appointed James Roger manager of the Rocky Mountain sales district. Roger, who has been Virginia district manager, will succeed George O. Hodgson, who is retiring after 41 years of service. Willard S. Hemker will take over the Virginia office.

Leeds & Northrup Co, Philadelphia, has opened a sales and service office in Seattle to serve Washington, Oregon, Idaho, and British Columbia. Stratford B. Biddle, Jr, is manager of the office, with Ira F. Omwake, Jr, as assistant.

Kuhlman Electric Co, Bay City, Mich., has opened a sales office in the Carry Building, 927 15th St, NW, Washington, D. C., under the supervision of G. Webber Knight.

REPRESENTATIVES

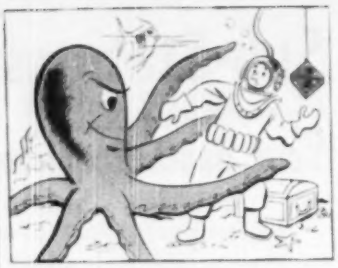
Standard Transformer Co, Warren, Ohio, has appointed A&A Supply Co, with offices at Albuquerque, N. M., and Abilene, Texas, representative for New Mexico and northwestern Texas.

Memco Engineering & Manufacturing Co, Inc, Commack, L. I., N. Y., has appointed Max I. Miller, Greensboro, N. C., and James W. Carroll, Charlotte, N. C., sales representatives for North and South Carolina, respectively.

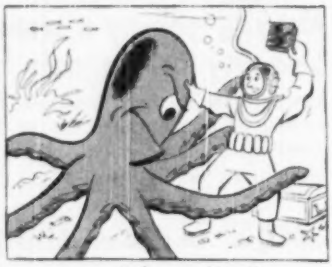
Electric Products Co, Cleveland, has appointed K. I. Clisby Associates, district representatives for eastern Pennsylvania, southern New Jersey, most of Maryland, and all of Delaware.

Metals Prices
July 8, 1950

COPPER, Conn. V., lb	$ 22½
LEAD, N. Y., lb	.11
ZINC, prime Western, E. St. Louis, lb	.15
TIN, Straits qual, N. Y., lb	82¾
ALUMINUM, base price	.17½
NICKEL, base price	.48
STEEL billets, Pitts., ton	53.00
STEEL scrap, No. 1 heavy, Pitts., ton	40.00



You can do a lot



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We all know unreasonable generalizations can be dangerously false. Common sense and on-the-job experience show us the value of dealing specifically with ideas, problems—and *people*.

Let's not make the big—and costly—mistake, then, of generalizing on religious or racial groups. Adopt and *carry out* these common sense principles:

1. Accept—or reject—people on *their individual worth.*
2. Don't listen to or spread rumors against a race or a religion.
3. Speak up, wherever we are, *against* prejudice. Work for understanding.

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UTILITIES

Proposed Construction

Alabama—Black Warrior Electric Membership Corp., Demopolis, 580 mi. rural distr. line, headquarters facilities and sys. imprv., Greene Co. **$1,485,000.**

Arizona—Bureau Reclamation, Dept. Interior, Phoenix, substation and transformers for Maricopa and Cochise substations, David Dam Proj., near Phoenix. Spec. R3-PX-29 (Region 3). L. N. McClellan, Bldg. 1-A, Denver Federal Center, Denver, Colo., ch. engr.

Arkansas—Woodruff Electric Co-operative Corp., Augusta, 151 mi. rural distr. line and sys. imprvs., Woodruff Co. **$275,000.**

Idaho—Bonneville Power Admin., Box 3537, Portland, Ore., Athol sub-station, Inv. 5242, Kootenai Co. Plans deposit $25. L. C. Stewart, Box 3537, Portland, Ore., engr.

Indiana—Johnson County R.E.M.C., Franklin, 14 mi. rural distr. line, headquarters facilities, sys. imprvs., Johnson Co. **$250,000.**

Iowa—Co-operative Electric Co. St., Ansgar, 82 mi. rural distr. lines, sys. imprvs., two-way radio and headquarters bldg., Mitchell Co. **$226,000.** Stanley Eng. Co., Hershey Bldg., Muscatine, consult. engr.

Missouri—Farmers Electric Co-operative, Chillicothe, 280.25 mi. rural distr. lines, Gentry, Davies, DeKalb, Livingston, Linn, Clinton, Caldwell, Chariton, Carroll and Kay Counties, **$375,000.** Frank Horton & Co., Lamar, engr.

Mo., El Dorado Springs—City, El Dorado Springs, power plant exten., generating equip. **$110,000.**

New Mexico—Roosevelt County Electric Co-operative, Portales, 113 mi. rural distr. lines and sys. imprvs., Roosevelt Co. **$390,000.**

North Carolina—Piedmont Electric Membership Corp., Hillsboro, 70 mi. rural distr. lines, Orange, Durham, Person, Alamance, Granville and Caswell Counties. Plans deposit $10. H. O. Vannort Engineers, 218 W. 2 St., Charlotte, engrs.

North Dakota—West Plains Electric Co-operative, Dickinson, 505 mi. rural distr. lines and service to new sub-station. **$725,000.** Ulteig Eng. Corp., 111 4½ Front St., Fargo, consult. engrs.

Oregon—Umatilla Electric Co-operative Assoc., Hermiston, 105 mi. rural distr. line, 28 mi. transmission line and sys. imprvs., Umatilla Co. **$660,000.**

Oregon—Bonneville Power Admin., Box 3537, Portland, construct Bandon substation, Coos Co., Inv. 5248; construct 71.8 mi. McKinley-Bandon, 115 kv. transmission line, Coos Co., Inv. 5244. Plans deposit $25 each.

South Dakota—Sioux Valley Empire Electric Assoc., Colman, 122 mi. rural distr. lines, Minnehaha Co. **$180,000.**

Tennessee—Volunteer Electric Co-operative, Decatur, 191 mi. rural distr. lines and sys. imprvs., Meigs Co. **$520,000.**

Tex., Brownfield—City, voted bonds, power plant imprvs. and sys. exten. **$350,000.**

Tex., Waco—Brazos River Transmission Electric Co-operative, Waco, 2 story, 46x90 ft. headquarters facilities, maintenance and storage, **$250,000.** Harris & Roberts, 1105 Medical Arts Bldg., archts.

Washington—Bonneville Power Admin., Box 3537, Portland, Ore., 9.5 mi. Jim Creek 115 kv. transmission lines, Snohomish Co. Plans deposit $25. L. C. Stewart, Portland, Ore., engr.

Wisconsin—Lafayette Electric Co-operative, Darlington, 7 mi. rural distr. line and headquarters facilities, Lafayette Co. **$102,000.**

Wyoming—Carland Light & Power Co., Powell, 90 mi. rural distr. line and sys. imprvs., Park Co., **$140,000.**

Wyoming—Bureau Reclamation, Dept. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing del. f.o.b. cars shipping point or f.o.b. cars Thermopolis power and lighting distr. board, heating board for Thermopolis Sub-station, Transmission Div., Missouri River Basin Proj., Spec. 3100. L. N. McClellan, ch. engr.

Low Bidders & Contracts Awarded

La., Lafayette—City Hall, June 20, electric distr., sys. addns., alterations, from Electrical Constr. Co., c/o Barnard & Burk, engrs., Triad Bldg., Baton Rouge, **$97,000.**

North Dakota—Baker Electric Co-operative, Cando, June 13, 505 mi. rural distr. lines, Benson and Pierce Counties, from Zontelli Constr. Co., Ironton, Minn., **$429,723.**

Pa. New Castle—Pennsylvania Power Co., 19 E. Washington St., 1 story, brick maintenance and repair shop, Newell Ave., adjacent to Cedar St. sub-station, to L. A. Haug, Temple Bldg., Approx. **$120,000.**

Washington—Bonneville Power Admin. Box 3537, Portland, Ore., second part switchyard extension circuit (Line No. 1) of Grand Coulee-Snohomish, 230 kv transmission line, 5.4 mi. Okanogan and Douglas Counties, to Smith Bros., Vancouver, **$105,197.** Bids 6/26.

Wyoming and Montana—Sheridan-Johnson Rural Electric Assn., Sheridan, 370 mi. rural distr. lines, Sheridan and Johnson Counties, Wyo. and Big Horn Co., Mont., to Douglas Contractor, Keeline Bldg., Omaha, Neb., **$493,161.** Bids 6/21.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Ark., Little Rock—State Hospital Nervous Diseases, Little Rock, plans by Trapp & Clippard, Pyramid Bldg., Little Rock, buildings for State Hospital, **$10,530,000.**

Mich., Detroit—Michigan Bell Telephone Co., 1365 Cass St., 8 story, 140x190 ft., stone, brick office, First and State Sts., **$6,000,000.**

Mich., Detroit—Charles T. Fisher, c/o Albert Kahn Associated Architects & Engineers, Inc., archt. and engr., 342 New Center Bldg., 11 story, 190x200 ft., stone, rein.-con. office bldg., West Grand Blvd. and 2 Ave. **$10,000,000.**

N. J., North Brunswick Twp.—Studebaker Corp., South Bend, Ind., assembly plant, 3 mi. southwest of New Brunswick along U. S. Rte 1 on 165 acre tract, **$3,500,000.**

N. Y., Rego Park—Park City, Inc., c/o Philip Birnbaum, archt., 12 E. 48 St., New York, Zone 17, 26 fourteen story apartments in area bounded by Horace Harding Blvd., 99 St., Queens Blvd. and Jewel Ave., **$35,814,800.**

O., Cleveland—Ford Motor Co., 3000 Schafer Rd., Dearborn, Mich., superstructure motor assembly plant, **$10,000,000.** F. A. Fairbrothers & Co. and George Miehls and Albert Kahn Assoc. Architects & Engineers, Inc., 345 New Center Bldg., Detroit, Mich., engrs. and archts.

Low Bidders & Contracts Awarded

Ill., Chicago—Irvin Park Manor, Inc., c/o John W. Harris Assocs., 134 S. La Salle St., 8 fourteen story apartments to be called Irvin Park Gardens on 57 acre site formerly Mid-City Golf Course. Owner builds, **$10,000,000.** Shaw, Metz & Dolio, 208 S. LaSalle St., Chicago 4, archts.

N. Y., Yonkers—Sol G. Atlas, 10 Grace Ave., Great Neck, suburban shopping center, on 46 acre site at Central Ave. and Cross County Parkway. Owner builds, **$8,000,000** Lathrop Douglass, 518 Fifth Ave., New York, 18, N. Y., archt. Site formerly owned by Mid-Hattan Corp.

BOOK REVIEWS

Steam Turbines and Their Cycles. **By J. K. Salisbury. Published by John Wiley & Sons, Inc, New York 16. 645 pages, illustrated. Price $9.**

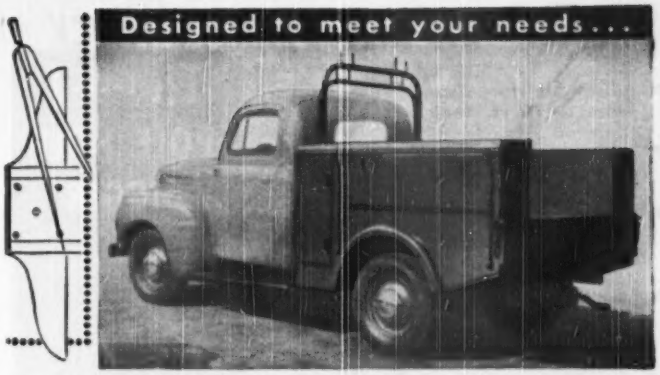
By means of this book engineers generally now will have access to information previously available to General Electric engineers and others enrolled in the Union College ESMWT program. There is so much specifically useful explication about the heat balance patterns associated with turbines, boilers and their accessories that the primary theme is that of accounting for every Btu from the appropriate turbine's admission valves all around the circuit to the same point. Basic instruction in thermodynamics, the various steam plant cycles and flow of fluids precedes the detailed analysis of turbine design and performance. More than half the pages are, however, devoted to removing the mysteries from heat-balance calculations by refined formulation and meticulous explanation. Naturally the losses in piping, heaters, evaporators are treated in precise manner as are the miscellaneous deductions of heat around the entire circuit. Incidentally, the corresponding techniques for gas turbines are incorporated at appropriate points. Closing chapters present installation facts, how to estimate efficiencies and heat rates. An appendix "blows up" the Mollier Chart to 19 full-page sections for increased accuracy along with abbreviated Keenan-Keyes steam rate tables.

Making Capitalism Work. **By Dexter M. Keezer and Associates. Published by McGraw-Hill Book Co, New York 18. 316 pages, illustrated. Price $3.50.**

The stake which everyone has in making capitalism work and the current interest in the encroachment of government upon the capitalistic system are both factors making this new book exceedingly timely and important. Although the book sticks reasonably close to fundamental economic theories, the style of writing and simplified illustrations make it easy reading for the layman. Of particular interest to the electrical industry is the pointing up of the need for "effective effort to obtain sympathetic popular understanding of the quality of capitalism's performance and particularly of its unique companionship with political and personal freedom."

Taxes and Economic Incentives. **By Lewis H. Kimmel. Published by The Brookings Institution, 212 pages. Price $2.50.**

The conclusions reached in this valuable contribution to the current problems of American business suggest that the encroachment of taxes on incentives is primarily an income tax problem. It is proposed that there be a careful integration of the federal, corporate, and personal income tax. Under the plan proposed in this study, a single normal tax roughly comparable to the present first-bracket rate for the personal income tax would be applicable to all incomes including corporate profits which would be taxed at the source. A goal of something like 10% for corporate income tax proper is poposed. Unlike many others in the business world, the authors take the view that sales and excise taxes should be revised but should not be sharply reduced. Like other Brookings Institution publications, this book is clearly written for easy understanding by the layman.



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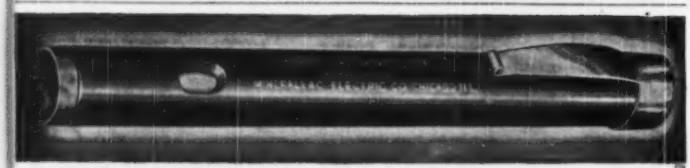

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CATALOGS • BULLETINS

● LIGHTING TEACHING PROGRAM: Two plan books introduce "Living With Light", a new program for teaching about light and sight in junior high schools, and to school authorities and utility executives. Teaching aids include a series of three film strips, six study leaflets for distribution to students, a teacher's guide, and other educational tools. Better Light Better Sight Bureau, 420 Lexington Ave, New York 17, N. Y.

● RUST CONTROL: For field and maintenance men in the light and power industry, a 6-page engineering data sheet has been prepared entitled "Field Information on the Arrest and Control of Rust." International Rustproof Corp, 12507 Plover Ave, Cleveland, Ohio.

● INSTRUMENT RENTAL: "Rental Instruments" provides technical data about the instruments as well as about equipment, supplies, and rental charges. Included are ac ammeters, ac-dc voltmeters, and wattmeters, all recording, and a current transformer. InstruRental Co, 411 Albee Bldg, Washington 5, D. C.

● SWITCHBOARDS: Units covered in Bulletin 18B6149A include duplex switchboards, benchboards for meter and relay concentrated control, and rectifier control cubicles. Allis-Chalmers Mfg Co, 932 S. 70th St, Milwaukee, Wis.

● FHP MOTORS: Illustrative material and data appear in a "Small Motor Catalog" which includes fractional-hp motors of undirectional, reversible, and synchronous types. Barber-Colman Co, Rockford, Ill.

● STEAM TRAPS: Traps for steam, air, and gasoline with pressures to 1,500 lb, as well as separators to 650 lb, are described in Catalog 250. There are capacity tables, installation diagrams, etc. W. H. Nicholson & Co, 12 Oregon St, Wilkes-Barre, Pa.

● VENTILATING: Fourteen broad classifications of heating, cooling, and ventilating equipment are illustrated and described in 136-page "How to Have Comfort from Moving Air." The Torrington Mfg Co, Box 808, Torrington, Conn.

● WIRING DEVICES: Catalog pages are available as follows: Flush motor plug receptacles, page 44-B; 3-wire grounding type adapter, page 52-D; receptacle-connector surface base, page 62-B; power receptacle, page 62-C; and 10 20-amp switches, page 68-A. Harvey Hubbell, Inc, Bridgeport 2, Conn.

● WIRING GUIDE: A pocket catalog contains tables and charts of code and wiring data essential to wiremen and contractors; requirements for most wire and cable sizes; photographs of, and tools for, connector installations. Burndy Engineering Co, New York 54, N. Y.

● MOTOR CUTAWAY: Construction features of the company's wound-rotor induction motors are presented with the aid of a large cross-sectional drawing in Folder 1400-PRD-198. There are also

speed-torque curves under various types of loading. Electric Machinery Mfg Co. Minneapolis 13, Minn.

● ELECTRIC FURNACE: Advantages and costs of electric melting, and features of the Hydro-Arc furnace appear in Bulletin FY-168. Whiting Corp, Harvey, Ill.

● RACEWAY SYSTEM: Catalog 606 lists, describes, and illustrates the Nepcoduct steel underfloor electrical raceway system for either new construction or modernization of office and other commercial structures. National Electric Products Corp, Chamber of Commerce Bldg, Pittsburgh 19, Pa.

● SWITCHES: The latest general catalog, No. 50, lists instrument transformer cabinets, meter troughs, transformer switch combinations, magnetic switches and relays, meter test blocks, and other switches, panels, and housings. The Palmer Electric & Mfg Co, Wakefield, Mass.

● FIRE EXTINGUISHERS: A periodic inspection chart is available to aid in keeping accurate records of extinguisher inspection. Ansul Chemical Co, Marinette, Wis.

● FLYASH COLLECTOR: A descriptive folder on the "LR" fly ash collector contains information on size, selection, and dimensions. Buell Engineering Co, Inc, 70 Pine St, New York 5, N. Y.

● CONTROL TRANSFORMERS: Double wound control transformers described in Catalog CST 2-50 are suitable for use with magnetic switches, heating controls, and solenoids. Ratings are: 115-230-380-460 v primary; 6-8-16-25-115-230 v secondary, 50/60 c. Super Electric Products Corp, 46 Oliver St, Newark 5, N. J.

● OCB's: Oil circuit breakers for indoor service in generating stations, substations, and industrial plants are described in Catalog 3360. They are rated at 7,200 v, 50,000 or 100,000 kva interrupting capacity. Roller Smith Corp, Bethlehem, Pa.

● MOTORS: Bulletin B-201 gives assembly information and speed-torque curves for open drip-proof, squirrel cage motors, ½ to 600 hp. Star Kimble Electric Co, 300 Bloomfield Ave, Bloomfield, N. J.

● LIGHTING: "Your Lighting Simplified" reviews desirable points that fluorescent lamp buyers should remember, and outlines a new lighting system designed to cut maintenance costs. The Edwin F. Guth Co, 2615 Washington Ave, St. Louis 3, Mo.

● COMMUNICATIONS SYSTEMS: "Power Plant Communication Systems" includes information about two-way apparatus for high noise-level locations. Illustrated are installations in all parts of the power plant. GAI-Tronics, Inc, P. O. Box 31, Reading, Pa.

● RURAL TRANSFORMERS: Information about 7,200-v and 14,400-y Ruralformers appears in a new catalog. Included are graphs showing melting time-current characteristics. Rural Transformer & Equipment Co, 632 N. 8th St, Milwaukee, Wis.

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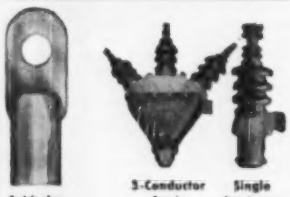

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TECHNICAL LITERATURE

Power Relays—A revision of the *American Standard for Relays Associated with Electric Power Apparatus* (C37.1-1950) reflects progress since 1937. In general, it includes new performance data such as fidelity of characteristics as affected by temperature, operating currents and voltages, wave form, and other factors; especially response to distance-type elements within certain limits of low voltage, high current and phase-angle deviations. Limits of temperature are now based on ambient temperature of 50 C instead of "above cooling air." Permissible temperature rise of wire-wound coils with Class A insulation was slightly reduced; there are no changes in requirements of Classes B and C insulation. Copies of the revised standard are available at 60¢ from American Standards Association, 70 E. 45th St, New York 17, N. Y.

Complex Numbers—A *Table of Powers of Complex Numbers* has been published to meet the needs of engineers, mathematicians and scientists working in such fields as ac circuits, number theory, and exterior ballistics. The table is said to be especially useful in the treatment of the Taylor Series involving complex variables. In this table, exact values of powers of complex numbers are given in Cartesian form for powers from 1 through 25 and for arguments with real and imaginary parts ranging separately from 0 to 10 in unit steps. The 44-page table by Herbert E. Salzer is in the Applied Mathematics Series AMS8. Price is 25¢ per copy from the Supt of Documents, U. S. Government Printing Office, Washington 25, D. C.

Heat-Power Symbols—A compilation of 44 *Graphical Symbols for Heat-Power Apparatus* has been approved by ASA as Standard Z32.2.6-1950. It is the sixth of a group of standards developed as revisions and expansions of existing standard Z32.2-1941. Leading power companies and their representatives were consulted. Clarity, simplicity, and nation-wide acceptance were basic considerations in assembling the symbols. Sponsors of the standard are AIEE and ASME. Copies are obtainable for 35¢ from American Standards Association, 70 E. 45th St, New York 17, N. Y.

School Lighting—*The ABC Plan for School Lighting* covers such topics as amount and kind of light needed, type and number of fixtures, lighting plans, and other factors. There are a number of convenient, easy-to-use tables and various arrangements are suggested for different types of fixtures. Booklet A-50064 may be requested from Westinghouse Electric Corp, P. O. Box 1017, Pittsburgh 30, Pa.

Foundations—A list of 120 annotated references to selected books and periodical articles published from 1924 to 1949 appear in *Bibliography on Machinery Foundations: Design, Construction, Vibration Elimination*. The references cover specific problems such as heavy machinery foundations on unstable soils, and the vibration problems related to foundations of electrical machinery, turbines, etc. This ESL Bibliography No. 5 may be purchased for $2 from the Engineering Societies Library, 29 W. 39th St, New York 18, N. Y.

Induction Heating—Induction heating applications are discussed in the May issue, Vol. 5, No. 3, of "Tempil Topics." Following a careful differentiation between induction and dielectric heating, some of the possibilities of induction heating are brought forward, including information

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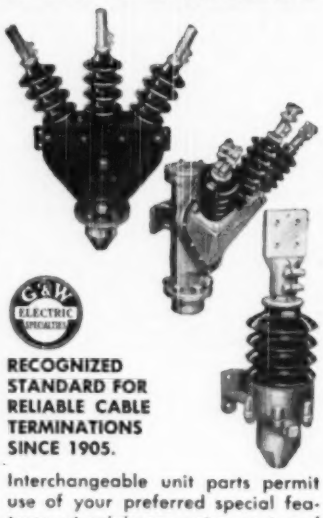

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about heat treating of steels. The broadside may be had upon request to Tempil Corp, 132 W. 22nd St, New York 11, N. Y.

Adhesives—The second compilation of *A.S.T.M. Standards on Adhesives*, issued in January 1950, has been made available. Test methods covered include: resistance of adhesive bonds to chemical reagents; tensile properties of adhesives; applied weight per unit area of dried adhesive solids and liquid adhesive; peel or stripping strength; strength properties in shear by compression loading and in plywood type construction. There is also a recommended practice for determining effect of artificial and natural light on the permanence of adhesives and new material on cleavage strength of metal-to-metal adhesives. Copies of this 60-page booklet can be procured at $1.25 from American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.

Fuel-Burning Equipment — *Fuel-Burning Equipment Dimensions Required by Smoke-Abatement Ordinances* provides tabulations showing that there is no common standard as to sizing of the equipment. Twelve tables list requirements of a number of representative cities. These include minimum furnace-setting heights for mechanical underfeed stokers under H.R.T. boilers; percentage difference in H.R.T. furnace-setting heights required from those recommended by the Stoker Manufacturers' Assoc; similar information for firebox and compact types of steel boilers, cast-iron boilers, underfeed stokers for water-tube boilers, maximum heat releases in Btu per hr per cu ft combustion space for underfeed stokers, pulverized coal firing and oil firing. There are nine diagrams of various types of boiler installations. Information Circular 7557 is obtainable from the Bureau of Mines, U. S. Dept of the Interior, Washington, D. C.

NBS Testing—Policy, general information, and fee schedules appear in *Testing by the National Bureau of Standards*. There are general descriptions of test methods used by the Bureau in the fields of electricity, metrology, heat and power, atomic and molecular physics, chemistry, mechanics, radio propagation, and optics. Under electrical measurement, there is information on measurements of resistance, inductance, and capacitance, instruments, magnetic materials, and electrochemistry. Heat power measurements include temperature, thermodynamics, lubrication, and automotive. Circular 483 may be secured for 25¢ from the Supt of Documents, U. S. Government Printing Office, Washington 25, D. C.

Building Regulations—The Twelfth Edition of Great Britain's *Regulations for the Electrical Equipment of Buildings* represents, in the main, a consolidation of and restatement of the previous edition and its supplement. Copies of this 201-page manual may be had at about 70¢ (3s/6d, paper bound) and about $1 (5s/0d, cloth bound) plus postage, from The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C. 2, Great Britain.

Copper—*ASTM Standards on Copper and Copper Alloys* is the latest compilation of specifications for copper, copper alloys, and other non-ferrous metals for electrical use. One section has 20 specifications on copper, copper alloy, and copper covered wire, rods, bars, and stranded conductors, as well as 13 specifications covering non-ferrous metals. A final division deals with test methods for copper and its alloys; these include expansion, mercurous nitrate, hardness, and grain size evaluation. This 500-page handbook is obtainable at $5 from American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.

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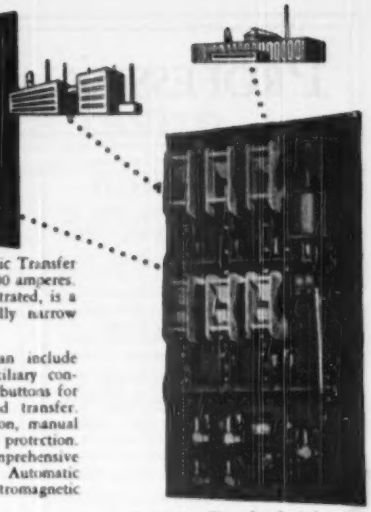

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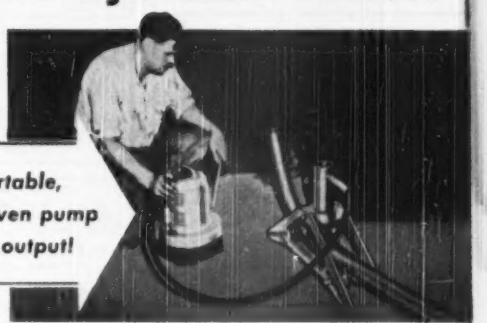

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P-7107, Electrical World
330 W. 42nd St., New York 18, N. Y.

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330 W. 42nd St., New York 18, N. Y.

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NEW YORK: 330 W. 42nd St. (18)
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SAN FRANCISCO: 68 Post St. (4)

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WANTED ESTIMATOR for Electrical Contractor. State age, education, experience record, salary expected in first letter. P-7088, Electrical World.

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POSITION WANTED

GRADUATE ELECTRICAL engineer, age 38, experience in development and test of protective devices and switches, design and operation of electric, water and gas distribution systems, military construction, system planning and teaching E. E. Desires position with opportunity in power field. PW-7167, Electrical World.

U. S. Government

UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Specifications No. 3106) will be received by Bureau of Reclamation, Denver, Colorado, August 3, 1950, and then publicly opened for furnishing two 35,000-kva, 13,800- to 115-000-volt, 3-phase, 60-cycle, oil-immersed, self-cooled, outdoor power transformers for Pole Hill and Flatiron Power Plants, Colorado-Big Thompson Project, Colorado. Delivery is desired within 790 days. For Particulars, address Bureau of Reclamation, Building 1-A, Denver Federal Center, Denver, Colorado.
MICHAEL W. STRAUS, Commissioner.
(100)

UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Specifications No. 3117) will be received by Bureau of Reclamation, Denver, Colorado, August 3, 1950, and then publicly opened for furnishing several lots of radio communication equipment for power plants and substations, Central Valley Project, California. Delivery is desired within 120-150 days. For particulars, address Bureau of Reclamation, Building 1-A, Denver Federal Center, Denver, Colorado.
MICHAEL W. STRAUS, Commissioner.
(100)

WANTED

4—46 KV outdoor, frame mounted oil circuit breakers, electrically operated, 500 M KVA minimum, 1,000 M KVA preferred, needed early fall.
Send details

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3— 333 KVA G-E 13800—120/240
3— 333 KVA G-E 11000—2300/4000Y
3— 333 KVA Wag 4600—115/230
4— 200 KVA Kuhl 33000—2400

3-phase, 60 cycles

1—1000 KVA Wag 6900—575
3— 750 KVA W-H 13800—480 Dry Type
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2—3333 KVA West. 69000—6900
1—7000 KVA Al. Ch. 66,000-24,000, 3 ph.
1—4500/6000 KVA G.E. 66000—33000, 3 ph.
3—1000 KVA West. 66000—7200
3— 100 KVA West. 44000—7200/12470 Y
3— 75 KVA G.E. 44,000-2300/4600
1—5000 KVA G.E. 33000—2300/4000, 3 ph.
3— 500 KVA G.E. 33000-460
6— 75 KVA Moloney 33000—2300/6900
6— 50 KVA G.E. 33000—2300
4— 450 KVA A.C. 25410/44000—13280/23000
3— 500 KVA G.E. 13800-480
3— 750 KVA West. 13200—440
3— 333 KVA G.E. 13200—2400/4160 Y
3— 167 KVA G.E. 7200/12400—240/480
3— 100 KVA Moloney 7200/12,470-2400/4160Y
1—1500 KVA West. 4000—2300, 3 ph. Auto
3— 250 KVA Al. Ch. 2300—460

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2—36 KVA G.E. 75/150 A. 4600 V.
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2— 600 A. 15 KV West. B-28-B-500 MVA**

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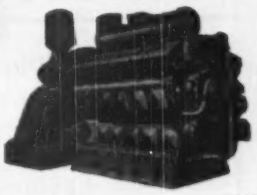

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1230	General Motors	16-278A	1900	720	312	General Motors	6-268A	450	1200
937.5	General Motors	12-567	1080	720	312	Clark	MD-4	375	327
625	Alco	6-12 1/4x13T	750	600	187	Ingersoll Rand	R	225	414
625	Baldwin	VO-6	510	450	175	General Motors	3-268A	160	1200
400	Buckeye	80	480	600	75	General Motors	6043C	90	1200

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500	Al. Ch.	Non Cond. 150 lbs. I.S.P. 5/10 lbs. B.P. 480 v 3 ph. 60 cy.
300	G.E.	Non-condensing 150/175 I.S.P. 5/10 B.P.—480 v. 3 ph. 60 cy.
400	Wlms.	Non-condensing—125/150 lbs. I.S.P. 5/10 lbs. B.P.—240/480 v. 3 ph. 60 cy.

SYNCHRONOUS CONDENSERS

KVA	Make	Type	Volts	Speed
8140	Wlms.	THC	2400/4160	900
6000	G.E.		2400/4160	900
3000	Wlms.		2400/4800	720

MOTOR GENERATOR SETS

3 ph. 60 cy.

KW	Make	Speed	DC Volts	AC Volts
1800	G.E.	600	125/250	2300/4160
1800	G.E.	360	275	2300/4400
1500	G.E.	600	600	2300/4160
1250	G.E.	600	275	4160
1000	Wlms.	900	600	4160
1000	G.E.	750	250	2300/4160

TRANSFORMERS—60 Cycle

K	Make	Type	Ph	Voltages
2666	Wlms.	OISC	1	66000x11000
2500	Al. Ch.	OISC	3	132000x2400
2500	Pack.	AT	3	13800x2300
1250	G.E.	RVDDJ	1	6600x2300
1000	Pitts.	OISC	1	12000/2400
600	Al. Ch.	OISC	3	2300/4160x230/440
333	Pitts.	OISC	1	26400x2300

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2000	KW	G.E.	25/60 cy. 2300/2300 v
800	KW	A. C.	25/60cy. 11000/2300v

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1— 500 KW G.E. 275 V 900 RPM 4150 Volt
2— 150 KW G.E. 125/250 V 1200 RPM 4150 Volt
1— 100 KW El. Mach. 1200 RPM 125/4150 Syn.

TRANSFORMERS

1—5000 KVA Amer. 3 Ph. 27,000V, 2300V.
2—4500 KVA G.E. 3 Ph. 27,000V, 2300V.
1—1500 KVA G.E. 3 Ph. 4150 V 2300 Pyranol
1—1000 KVA G.E. 3 Ph. 4150 V 2400 V
1—1000 G.E. 3 Ph. 4150 2 Ph. 2400 V
1— 500 KVA Kuhlman 1 Ph. 4150 V, 2300 V
3— 400 KVA G.E. 6900 2300 V Sec.
3— 150 KVA G.E. 4150-240/480 V Pyranol
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HP	Make	Type	Speed
400	*Al. Ch.	ANW	900
300	G.E.	FT-508A	1800
250	Westg.	CS-504A	600
200	Reliance	AA-C60858	1200
200	*G.E.	IE-15-K	1200
150	Westg.	CS-771	1800
150	G.E.	IE-13AK	1800

SLIP-RING MOTORS

3 phase, 60 Cycle—220 or 440 Volt (2200 volt or higher)

HP	Make	Type	Speed
800	*Westg.	CW	507
650	Westg.	HE	360
500	Westg.	CW	360
500	Westg.	CW	452
400	G.E.	IE	1800
300	G.E.	IE15A-4	1800
300	G.E.	IM-17	1200

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000	G.E.	4600	275
500	G.E.	2300	230
500	G.E.	440	250
500	G.E.	4000	1200
450	G.E.	2300	250
200	Cr.Wh.	2300	125
200	G.E.	440	250
180	Al.Ch.	229	125

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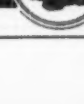

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LETTERS TO THE EDITOR

For the Board of Directors

To the Editor of ELECTRICAL WORLD:

If available I would like very much to have eight additional copies of ELECTRICAL WORLD of May 22 under the general heading of "Blueprinting the Future" . . . I consider it important to place this issue of the ELECTRICAL WORLD in the hands of each member of our board of directors.

F. B. Culley
President
Southern Indiana Gas & Electric Co
Evansville, Ind.

(Editors Note: To date 86 requests have been received from individuals and organizations for 8,056 reprints of this issue.)

Hazards of Star Primaries

To the Editor of ELECTRICAL WORLD:

A severe outage on our 4.16-kv, 4-wire distribution system has started us wondering about the hazards of this type of system for city service.

In Greenwood the present electric load of 4,500 kw is supplied from a 44-kv circuit through three 2,000-kva transformers with their secondaries connected star for 4.16 kv and neutral grounded. In 1940, distribution switches were incorporated in a metering and switching station about 400 ft from the 44—4.16-kv station. Main phase wires from supply to substation are 350,000 cir mils bare copper. In 1945 a fourth circuit was taken out of the primary station but was connected within 20 ft of primary station buses. With one or two exceptions, all 3-ph transformer banks in the city are connected star primary and delta secondary.

During construction in March, a 4/0 TB wire, connected to the system but otherwise dead, was pulled up into one of the main phase wires ahead of the switching station. This burned one main phase wire down. As soon as this main phase wire was opened ahead of the 4.16-kv switching station, 3-ph transformer banks in feeder circuits began to pump back into the dead primary phase through delta connected secondaries.

Fuses were blown over much of the area, particularly in the concentrated business section. One bank of three 100-kva transformers had a 180-kva. 3-ph capacitor connected within 50 circuit-feet. The surge literally blew the 100-amp porcelain fuse blocks completely to pieces and off the crossarms, letting a high voltage lead swing down and burn a hole in the transformer case with resultant loss of oil. A second bank of similar transformers 1,500 circuit-feet from the above bank had two of the three blocks blown off the crossarms. Where transformers were smaller, the fuses only were blown. Star-primary-star secondary banks were, of course, not affected. Transformer fuses as far as 1½ miles away were blown and a total of 19 primary fuses went out. No single phase transformer fuses were blown. Service was restored in 1¼ hr.

We sincerely hope that we can get discussion started about star primary connections for city service, as the same accident could happen on a main bus of a heavily loaded city substation and the results would be "out of this world."

F. W. Chapman
Superintendent
Commissioners of Public Works
Greenwood, South Carolina

Anti-Twist Weights

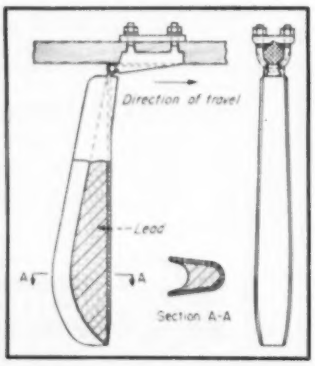
To the Editor of ELECTRICAL WORLD:

We have noted the letters from several correspondents regarding anti-twist weights . . . for . . . self supporting type aerial cable.

Several French and German line equipment manufacturers produced a range of such anti-twist devices prior to World War II, and the writer first saw this unit being applied to the installation of SS type cable in Germany in 1935.

Attached is an abstract . . . from a French electrical manufacturer illustrating a standard device. Possibly your correspondents and your equipment manufacturers in this country will be interested in the design shown.

H. W. Biskeborn
Technical Director
Kaiser Aluminum & Chemical Corp
Newark, Ohio



Thin Concrete Floors

To the Editor of ELECTRICAL WORLD:

The June 5 issue of ELECTRICAL WORLD describing the Philip Sporn Station was quite interesting. I am particularly interested in the statement by H. A. Kammer on page 108, column one: "instead of conventional wood formed concrete floor slabs or steel gratings, steel decking with a thin concrete covering was used, etc." I would like to find what was used and any other pertinent data that might be available to make a study of cost.

D. H. Cochran
Control Division
Engineering Dept.
E. I. du Pont de Nemours & Company
Wilmington 98, Delaware

IN REPLY . . . For the past five or six years we have been using the "Q" decking for most of the floors around our power houses. We have found that we have been able to install the steel decking and pour a light concrete slab on top of same for less money than we can install the conventional construction, ie wood forms on which is poured a reinforced concrete slab. All our power house construction work (when contracted) is handled on a unit price basis and invariably the contractors bidding our work have submitted a single unit price for the construction of wood forms. Thus a square foot of floor form costs the same as a square foot of more complicated form, for example, turbine foundation.

Besides making an appreciable saving in the cost of the floors we also have found that the use of the steel decking saves us a great deal of time and money in the erection and installation of the equipment. If you are familiar with power house construction I am sure you will appreciate the delays that are brought about by the erection of, say, a boiler and other equipment, because floor slabs are not in place at the time erection of this equipment is started, and the resultant cost of temporary decking and planking that has to be installed unless the equipment erection is held up.

H. A. Kammer
Vice President
American Gas & Electric Service Corp
30 Church St
New York City

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See Page 159

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

2700-kva capacitor equipment, fuses connected, automatically switched in three steps in response to system voltage level.

WESTINGHOUSE HOUSED CAPACITOR UNITS

Keep Voltage—AND COSTS—in line!

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A compact design allows for smaller substation space . . . lower real estate costs.

Factory assembly assures low installation costs. You need only mount the housing on pads, set capacitor units in place, and make primary connections.

Complete interlocking assures safety to personnel—shorting and grounding the capacitors before housing can be entered.

A self-contained design saves the cost of installing external accessories.

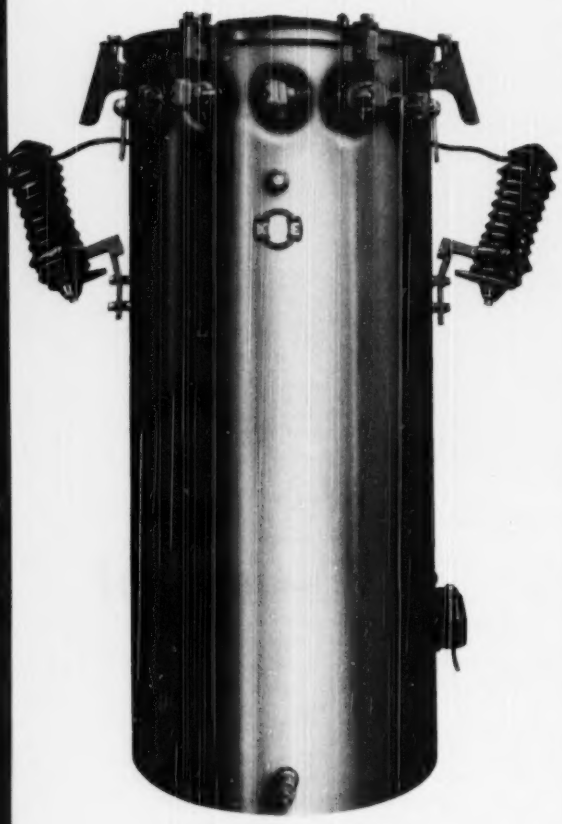
Savings like these are supplemented by extra revenue when good voltage control is maintained at the substation. And Westinghouse housed equipment with built-in automatic control—responsive to line voltage, load current or kva load—assures the finest.

For complete information on Westinghouse Inerteen Capacitors, write for Booklet B-4343. Address: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-60723

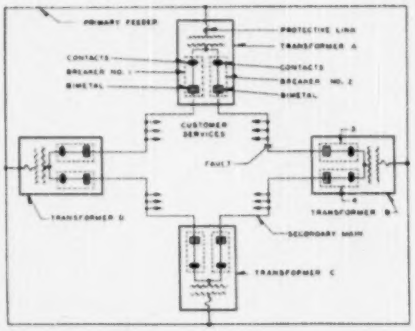
Westinghouse

CAPACITORS

HOW KUHLMAN CSPB TRANSFORMERS PROVIDE POSITIVE PROTECTION

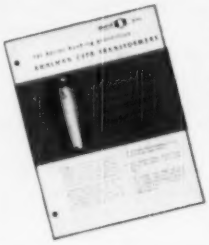


In high load areas, distribution transformers are often banked by connecting both primaries and secondaries in a closed loop. This allows all transformers in the bank to "gang up" to supply power to any point requiring a sudden increased amount. The Kuhlman CSPB Transformer is the ideal bank equipment because its "built-in" circuit breakers and other well known safety features provide positive protection against concentration of power at fault points, surge voltage, short time overloads and interruption to customer service.



Here's how the Kuhlman CSPB Transformer operates in case of a fault occurring at "X":

1. Fault current is supplied by the transformers in inverse proportion to the total impedance from each transformer.
2. Transformers A and B, being adjacent to the fault, supply the bulk of the fault current. This combines with the fault currents supplied by transformers C and D, flowing through the bimetals of breakers 2 and 3.
3. At the same time, the fault currents from C and D oppose the load currents in breakers 1 and 4, assuring that breakers 2 and 3 will open and isolate the faulted section.
4. With the faulted section isolated, transformers A and B will continue to furnish their former share of the load through breakers 1 and 4 to the remaining network.
5. Fault location is easily determined by locating the transformers which show a red signal light.



This brand new Kuhlman Bulletin CS-302 describes in detail the features and operational advantages of Kuhlman CSPB Transformers. Send for it today! Also available on request are new bulletins on Kuhlman Conventional, Power, Dry Type, Street Lighting and Specialty Transformers.

EXPERIENCE COUNTS — THIS IS OUR 56TH YEAR

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